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A Review of the Maruins or Biting Midges of the Genus *Culicoides* (Diptera: Ceratopogonidae) in the Amazon Basin[1)]

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I. Introduction

Biting midges of the genus *Culicoides* LATREILLE were reported as notorious blood-sucking pests by the earliest explorers to the Amazon. Known by the Portuguese name of 'maruin' in the mangrove swamps or mosquitos polvora' in the rain forests, they took their place beside the mosquitoes, simuliids, and tabanids in the hordes of bloodsucking insects which brought sickness and discouragement to all who would penetrate the forest. THEODORE ROOSEVELT said when he returned from the Amazon that the most dangerous animals he met were the insects (WALLACE 1853; BATES 1863; BEQUAERT 1926).

WALLACE (1853), sojourning on the headwaters of the Rio Negro on the Brazil-Venezuelan border, wrote: "I was..... exposed to the pest of the sand-flies, which, every afternoon, from four to six, swarm in millions, causing by their bites on the face, ears, and hands, the most painful irritation. Often I have been obliged to start up from my seat, dash down my pencil, and wave my hands about in the cool air to get a little relief. But the sun was getting low, and I must return to my task, till, before I had finished, my hands would be as rough and as red as a boiled lobster, and had violently inflamed. Bathing them in cold water, however, and half an hour's rest, would bring them to their natural state; in which respect the bite of this little insect is far preferable to that of the mosquito, the pium, or the mutuca, the effects of whose bites are felt for days."

The first Amazon *Culicoides* was described from Belem as *Haematomyidium paraense* in 1905 by the pioneer Brazilian medical entomologist, Dr. EMILIO GOELDI, incidental to his famous work on "Os Mosquitos no Para." The first comprehensive work on Brazilian *Culicoides* was published by LUTZ (1913; 1914) in which eleven species were reported, two of them from the Amazon region. Practically nothing new was added until 1937 when Costa Lima reviewed LUTZ' collection and published a key to the Brazilian species. Work really began on the Brazilian fauna shortly thereafter, with a long series of papers and revisions by BARRETTO (1944), LANE (1945), BARBOSA (1947), FORATTINI (1957), and FORATTINI, RABELLO and PATTOLI (1958). Most of this work was done in southern Brazil around Rio de Janeiro and São Paulo, and the Amazon region remained comparatively neglected. How serious this neglect has been is shown by the fact that of the 60 Amazon species we are treating here, Amazon records of only 13 species were compiled by FORATTINI (1957) in the latest Neotropical revision.

It was with great enthusiasm and expectations, therefore, that we accepted the invitations of two organizations to work up the *Culicoides* material from their research programs in the Amazon.

Dr. ERNST J. FITTKAU of the Max-Planck-Institut für Limnologie in Plön, Germany, very generously sent us the Ceratopogonidae he collected during his three year trip to the Amazon from August 1960 to April 1963. Dr. FITTKAU took large collections of *Culicoides* at light on the Rio Marauia in Amazonas and the Rio Parú de Oeste in Pará. At the missions where most of these collections were made these rivers were 30 to 50 meters wide with strong current and many rapids where they came out of the foothills of the mountains forming the boundary between Brazil and Venezuela and the Guianas. Lesser collections were taken in the following localities in Amazonas: Rio Cuieiras, December 1961; Rio Solimões, August 1961; Rio Prêto, July 1962; Rio Taruma, November 1962; and Rio Negro, February 1963 (Fig. 1).

FITTKAU numbered his collections in sequence and entered them in his journal with detailed collecting notes. He grouped his collections from various areas under certain lettered designations which are shown on Fig. 1 and listed as follows:

A: Area of Belém; A1–A10, A34–A35, A390–A392.
B: Rio Madeira and left-side tributaries; A10–A30, A311–A312, A 328.
C: Lower Rio Negro, its tributaries and area of Manaus; A31–A32, A56–A86, A115–A125, A145–A182, A185–A220, A265–A267, A275–A310, A381–A389, A393–A443.
D: Lower Tocantins near Marabá; A36–A55.
E: Lower Tapajós, area of Santarém; A87.
F: Rio Cururú, right tributary of the upper Tapajós; A88–A114.
G: Rio Solimões; A229–A264.
GI: Lower Rio Solimões, transitional region to the Rio Amazon; A126–A144, A183–A184, A221–A228.
H: Rio Aripuana, right tributary to the lower Rio Madeira; A313–A327.
I: Middle section of the Rio Negro, above the mouth of the Rio Branco, and left side tributaries; A329–A353.
K: Upper section of the Rio Parú de Oeste, border region of Surinam; A354–A380.
L: Rio Marauiá, a left side tributary of the upper Rio Negro, border region of Venezuela; A444–A511.
M: Atlantic coast region north of Capanema and Braganca.

Dr. THOMAS H.G. AITKEN of the Belém Virus Laboratory of the Instituto Evandro Chagas (supported by the Fundação Serviços de Saúde Publica and the Rockefeller Foundation) conducted a three year study of *Culicoides* taken in light traps in the APEG Forest preserve. The Área de Pesquisas Ecológicas do Guamá (APEG) is a forest preserve lying within the boundaries of the Agricultural Research Center (IPEAN-Instituto de Pesquisas e Experimentação Agropecuárias do Norte) on the eastern outskirts of Belém. The APEG Forest lies on the north bank of the Guamá River, "which, although entirely fresh water, undergoes periodic tidal fluctuations. The humid tropical vegetation of the APEG comprises 1) relatively undisturbed várzea forest, 2) moderately disturbed forest of the terra firme, and 3) a narrow strip of relatively new second growth (capoeira) and overgrown rubber plantation. The APEG is a part of a long strip of uninterrupted tropical rain forest which lies along the north bank of the Guamá" (CONDURÚ 1968.) A smaller collection was made in a wet campo serving as a water buffalo pasture in the IPEAN adjacent to the APEG Forest.

Acknowledgments

This study would not have been possible without the extensive collections and constant help and encouragement of Dr. THOMAS H.G. AITKEN of the Belém Virus Laboratory of the Instituto Evandro Chagas, and Dr. ERNST J. FITTKAU of the Max-Planck-Institut für Limnologie in Plön, Germany.

We acknowledge the generous co-operation of Dr. MIGUEL CORDEIRO DE AZEVEDO, director of the Instituto Evandro Chagas, and Dr. LUIS SCAFF, Director of the Museu Paraense Emilio Goeldi in Belém. Field work in the Guamá Ecological Research Area (APEG) was conducted with the kind cooperation of Dr. ALFONSO WISNIEWSKI, Director, and Dr. JOSÉ MARIA CONDURÚ, past director, of the Instituto de Pesquisas e Experimentação Agropecuárias do Norte (IPEAN).

At the Belém Virus Laboratory Dona Amazonia Toda Tang, Srs. EMANUEL NAZARENO DE FREITAS, ORLANDO VAZ DA SILVA and JORGE MAIA DO NASCIMENTO gave valuable technical assistance in Dr. AITKEN's entomological program.

For Amazonian records of Colombian *Culicoides* we are most grateful to Dr. C.J. MARINKELLE of the Department of Parasitology and Tropical Medicine of the Universidade de los Andes, Bogotá, Colombia.

We are indebted to Miss GLORIA GORDON for making the *Culicoides* illustrations.

Types of our new species are deposited in the Museum de Zoologia, Universidade de São Paulo, São Paulo, Brazil. Paratypes,when available, will be deposited in the following collections: Museu Paraense "Emilio Goeldi" in Belém, Brazil; Instituto Nacional de Pesquisas da Amazonia, Manaus, Brazil; Museu Nacional in Rio de Janeiro, Brazil; Faculdade de Higiene e Saude Publica da Universidade de São Paulo, Brazil; Max-Planck-Institut für Limnologie, Abt. Tropenökologie, Plön, Germany; British Museum (Natural History), London, England; and the U.S. National Museum of Natural History in Washington, D.C.

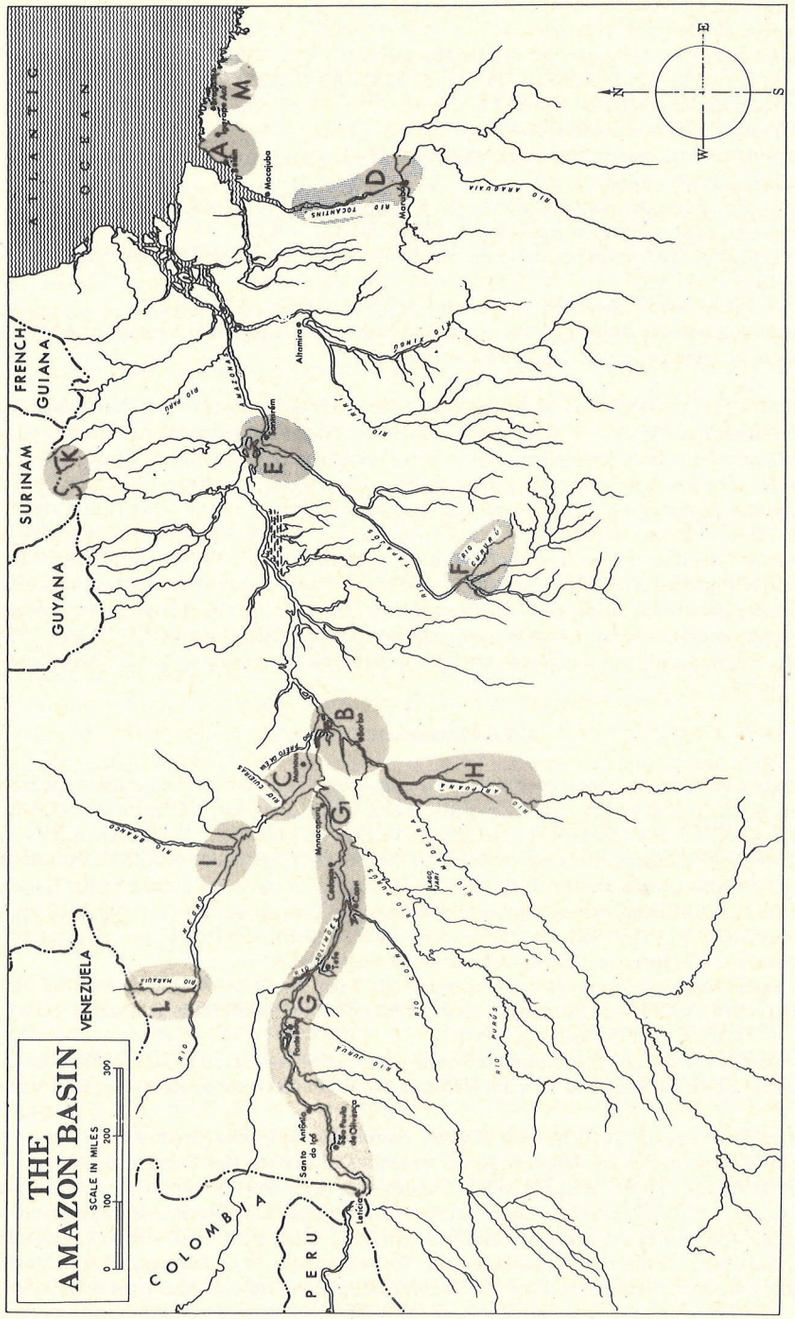

Fig. 1. The Central Amazon Basin, showing collecting regions (from FLINT 1971).

1) Geography.

The Amazon is the mightiest river in the world, and its statistics are enough to stifle the imagination. In its 5 300 km long course from west to east across nearly the entire breadth of the South American continent from the headwaters of the Maranon in the Andes, most of its drainage basin is in an area of high rainfall which reaches as much as 4 000–5 000 mm annually at the base of the Andes. SIOLI (1968) states that the total Amazonian drainage area is 7 050 000 km^2, more than twice that of the Mississippi-Missouri system in North America (3 248 000 km^2). OLTMAN (1967) records an average annual discharge at the Óbidos narrows based on careful measurements of 157 000 cubic meters per second, which he estimates would increase to about 19 000 cms at its mouth. This is 15 to 20% of the entire flow into the oceans of all the rivers of the world.

According to SIOLI (1968) the Amazon basin began in the Palaeozoic as a westward flowing drainage from the primeval granites and gneisses of the Guiana Highlands in the north and the Brazilian Massif in the south. Over an immense period of time this relatively stable system deposited as much as 2 500 m of sedimentary limestones, schists, and gypsite in the Amazonian Embayment of the Pacific, and through the Mesozoic built up deposits of sandstone. In the Tertiary the uplift of the Andes Cordillera cut off the Amazon from the Pacific and it flowed into a large freshwater lake, which first drained northwest into the Caribbean Sea and finally in the Pleistocene opened eastward and developed the present Amazon channels to the Atlantic. During the Pleistocene sea-level changes, forests colonized the old lake bottom and the Amazon developed deep channels near its eastern mouth. These channels presently have the configuration of drowned valleys in certain lower tributaries of the Amazon. This history has contributed to the following unique characteristics of the Amazon River system:

1. The chemical composition of the waters, draining the ancient granites and gneisses of the Guiana and Brazilian Highlands, and passing through the sandstones of the lower country, is exceedingly deficient in dissolved electrolytes. The Amazon waters are among the poorest in the world in dissolved salts, especially of calcium and phosphorus, resulting in a very low productivity.
2. The low gradient of the main course of the Amazon itself. The low relief of the basin results in many characteristic features such as the igapós or river swamp forests, the many river lakes, and the várzea floodland formations with channel islands and temporary natural levees on the channel margins (Fig. 2).
3. In spite of the small gradient the current in the main Amazon is quite strong, averaging 1–2 miles per hour in the dry season and twice this in the flood. This is due to the great volume of the river, and also to the depth of the river bed, which in portions of the lower course goes down to about 90 m.
4. The anastomoses of the headwater systems of the Amazon through the Casiquiare Canal with the Orinoco and through the Guaporé system in Bolivia with the Paraguay have permitted considerable faunal interchange in times past. Thus FITTKAU (1969) points out that faunistically the Paraguay River has many similarities to the Amazon.

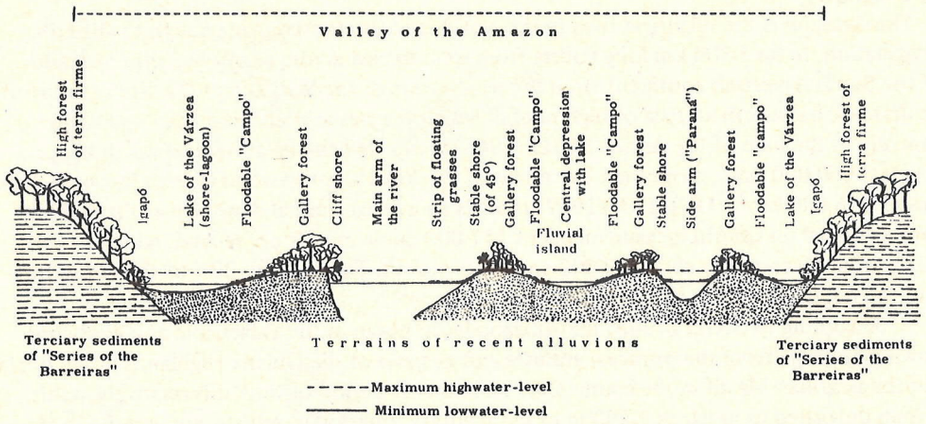

Fig. 2. Schematic cross section through the lower Amazon Valley, height exaggerated (from SIOLI 1964).

The tributary rivers of the Amazon Valley are of three main types (SIOLI 1964):

1. "White waters", such as the Rio Madeira, Rio Branco and the Amazon itself. Rivers of turbid yellowish colour draining the mountainous terrain of the Andes and Venezuelan Parima, where high rainfall and erosion contribute to a heavy sediment load (pH 6,2–7,2; transparency between 10 and 60 cm).
2. "Clear waters", such as the Rio Tapajós and Rio Xingú draining the lower massifs of central Brazil, and others from Guianas,with less rainfall and less runoff (pH 4,5–7,8; transparency between 60 cm and 4 m).
3. "Black waters", like the Rio Negro and Rio Cururú. Draining relatively flat regions where the brown colour is due to colloidal humic material from the bleached white sands or podzols of the caatinga forest, campinas, and campos, (pH 3,8–4,9; transparency 1–2 m). These are starvation waters, poor in fish and other aquatic life, the low productivity resulting from the low level of dissolved salts and the opacity of the water to sunlight.

The Amazon basin, situated astride the equator, is tropical in the true sense of the word. The moist prevailing tropical east winds are funneled through the mouth of the Amazon Valley between the Guiana and Brazilian highlands. The moisture brought in by these winds condense during the strong convectional heating over the land, bringing abundant rainfall. The extensive rivers then yield water by evaporation which by further convection in the rising elevations near the borders of the basin affords constant heavier rainfall the year round.

In most of the Amazon Valley the climate falls within the Af type in KÖPPEN's classification. Monthly and annual mean temperature ranges are less than 3°C throughout the area, the average maximum temperature at Belém being 32,2°C and the average minimum temperature 23,1°C. Rainfall is much greater and more constant in the western portion of the basin, where as much as 10 000 mm per year falls just beyond the basin in Chocó, Colombia. This compares with 2 500 mm annually at Iquitos, Peru, 1 500 mm at Óbidos, and 2 838 mm at Belém. Near the Atlantic coast at Belém and to some extent as far as Manaus there is a distinct dry season from June to November, but not so marked as to alter the rain forest vegetation.

FITTKAU (1969) gave an excellent review of the zoogeography of South America. Special mention must also be made of a faunal analysis of the genus *Heliconius* (Lepidoptera) by EMSLEY (1965), and the proposals for faunal provinces based on Arachnida by Leitão (1946) and on mammals by CABRERA and YEPES (1940). In these reviews the tropical rain forests in the river systems of the Amazon and Orinoco are given the name Hylaea Province (FITTKAU), or Distrito Amazonico (CABRERA and YEPES).

FITTKAU (1969, p. 469) points out the extraordinary richness in species of the Hylaea Province. In a small river more than 100 species of fishes may be found, while in a small rainforest stream of one meter width a hundred species of chironomid midges may emerge in a single day. BATES collected 1 200 species of butterflies from the mouth of the Amazon to Tefé and found 400 species in Belém alone. FITTKAU attributes this evolutionary proliferation to the proximity of the Guiana and Brazilian continental blocks acting as isolated evolutionary centers operating under remarkably favorable and uniform climatic conditions for evolutionary differentiation and survival.

HAFFER (1969) goes further and calls attention to the great extension of the dense rain forests on to the emerging Amazon Basin at the end of the Tertiary, and "the repeated contraction and expansion of these forests as a result of climatic fluctuations during the Quaternary, leading to repeated isolation and rejoining of forest animal populations..... The presumably smaller niche size (and lower population density) of tropical relative to temperate zone forest animals and the corresponding higher rate of speciation in the tropics under conditions of large-scale climatic fluctuations may explain the rapid differentiation of tropical forest faunas during the Pleistocene."

HAFFER postulated the existence of six major forest refuges in the Amazon Basin during the drier cycles of the Quaternary climatic oscillations: 1) Napo refuge in eastern Ecuador centering around the Rio Napo; 2) East Peruvian refuges at the eastern base of the Peruvian Andes; 3) Madeira-Tapajós refuge between the middle Madeira and the upper Rio Tapajós; 4) Imeri refuge, between the headwaters of the Orinoco and Rio Negro; 5) Guiana refuge, on the northern slope and foreland of the mountains of the Guianas, and 6) Belém refuge, south of the mouth of the Amazon and east of the lower Tocantins.

FITTKAU (1969; 1971 b) divided the present Amazon rain forest into four districts (Fig. 3):

1. Central Amazon. The soils are leached sands and clays derived from the Tertiary freshwater lake bed, and are extremely poor in mineral salts. Streams arising in this district are nearly pure rainwater with a pH usually near 4,5. Such impoverished waters permit only traces of primary production and green algae, submersed aquatic vegetation, and calcareous shell-bearing mollusks are absent. The aquatic food chain begins with allochthonous material which falls into the water. Mosquitoes are absent except for those which breed in water in tree holes, epiphytic bromeliads, and the like. Chironomids are very numerous in the small streams, but decrease in numbers as the streams become larger.

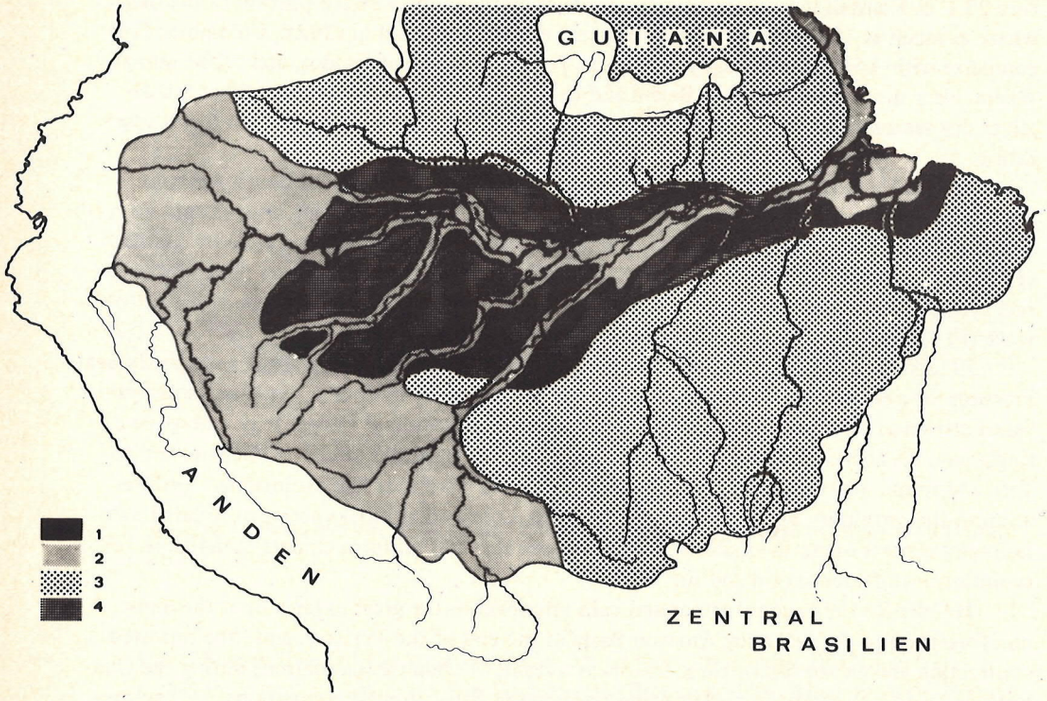

Fig. 3. Four biotic districts of the Amazon Valley (from FITTKAU 1969).

2. Andean foreland and alluvial land formation (várzea) of Andean and pre-Andean rivers in the central Amazonian region. Soils are formed from calcareous marine sediments or recent alluvia from the Andes, rich in nutrients, with pH often reaching 7, and are the most fertile in Amazonia. The rivers which arise in the Andes and Andean foothills all carry loads of sediment which make the water turbid and loamy and hinder the growth of submersed vegetation. The large rivers have carved broad valleys in the central Amazonian plain and filled them to varying degrees with sediments from their sources. In the annual floods these deposits are eroded and redeposited, annually enriching the soils of the várzea or floodplain, forming the only presently usable soils of Amazonia. During the months of high water levels many river lakes, some quite large,are formed in the várzea, their waters rich in nutrients. As the water recedes, abundant floating and emergent vegetation develops, which produces high populations of chironomids and other aquatic insects. The floating meadows of *Panicum* and *Paspalum* grasses and *Eichhornia, Pistia,* and *Salvinia* are especially productive.

3. Northern and southern border districts. The soils are formed from the bedrock of the Precambrian Brazilian and Guianan Shields, which are partly covered by Paleozoic to Mesozoic layers and recent sand alluvia. Geochemically they are richer than the central Amazon district, with pH mostly between 5,5 and 6,5. Streams have a moderate to well developed flora and fauna; green algae, submersed flowering plants, and mollusks with calcareous shells

are present. Mosquitoes breed in small forest pools and in rock pools. The chironomid fauna is rich, especially in the streams and rivers, and that of the Guianan border district is essentially the same as that of the Brazilian border district to the south.

4. Carboniferous strips, calcareous formations in the region of Paleozoic marine deposits, flora and fauna optimally developed, rich in mollusks.

The *Culicoides* collected by AITKEN in the relative species-rich várzea formation of the APEG Forest at Belém (category 2) are in marked contrast to those made by FITTKAU in the northern border district (category 3).

To begin with, the species *acotylus, foxi, hylas, insignis, leopoldoi, paraensis,* and *pseudodiabolicus* are widespread neotropical species and are found in many places in and out of the rain forest. FITTKAU found only five species, *dasyophrus, foxi, fusipalpis, lutzi,* and *paucienfuscatus,* to be abundant in his light trap collections from the headwaters of the Rio Parú de Oeste, the Rio Cuieiras, and the Rio Marauia and its tributaries. In contrast, AITKEN took large numbers of nine species, *batesi, belemensis, foxi, fusipalpus, glabrior, hylas, leopoldoi, limai,* and *pseudodiabolicus,* in his traps in the APEG Forest at Belém. The lists of total *Culicoides* species collected in these localities provides an even greater contrast. In the nutrient poor headwater streams FITTKAU collected a total of only 15 *Culicoides* species, while AITKEN took 44 species in the APEG Forest, probably mostly developing in the more fertile várzea. By way of comparison, WIRTH and BLANTON (1959) reported a total of 57 *Culicoides* species from the Mojinga Swamp rain forest of the Panama Canal Zone, although the proximity of tidal mangrove swamps brought in a few species which should not be counted in the comparison.

2) Ecological succession on the Lower Amazon.

RICHARDS (1952) described the development of rain forest vegetation in the hydroseres on the banks of furos or channels of the delta region between the mouth of the Amazon proper and the Rio Pará. *The water is tidal but more or less fresh.* New islands of alluvium are constantly being built up and consolidated by the growth of vegetation. The first plants to colonize the islands are supplanted by others which can establish themselves only in their shelter. As the succession proceeds the island grows in area with the first colonists occupying the outer rings in the zonation of the succession. A similar succession and zonation takes place on the convex banks of the meanders in the channels. We believe that the details of this succession are so vital to an ecological understanding of AITKEN's *Culicoides* collections from the APEG Forest that we are justified in quoting at length from RICHARD's excellent description.

"The first pioneers on the mud are *Montrichardia arborescens*, a robust aroid growing to 2–3 m., and *Drepanocarpus (Machaerium) lunatus,* a leguminous shrub. These two species form practically pure communities, one seeming to exclude the other; often the two consocies alternate every 10 m or so. Both species have seeds which float and are abundant in the river drift. Germination is exceptionally rapid and the seedlings can establish themselves between two successive tides; in this respect these plants resemble mangroves. In the shelter provided by the Montrichardietum and Drepanocarpetum a quite different type of vegetation develops, a "sud" or floating sward consisting of masses of the grass *Hymenachne amplexicaulis,* together with *Eichhornia azurea* and *E. crassipes.* This last community is much more extensively developed higher up the Amazon above the influence of the tides. There it may become rooted and play a part in the succession, but in the furos region its role is not impor-

tant.

"The second stage in the succession is the invasion of the *Montrichardia* and *Drepanocarpus* communities by the mangrove *Rhizophora racemosa*. This forms a consocies stretching as far upstream as the influence of the tides; it is not, like most mangroves, confined to salt and brackish water..... In places *Rhizophora* is replaced by other mangroves, *Avicennia tomentosa, A. nitida* and *Laguncularia*; these,too, grow here in water which is said to be never salt or even brackish. The mangroves soon shade out *Montrichardia* and *Drepanocarpus* and beneath them there is only very scanty undergrowth.

"After a time seedlings of the palms *Euterpe oleracea* and *Mauritia flexuosa* and of the dicotyledonous trees *Cecropia palmata* and *C. paraensis* establish themselves beneath the mangroves. The genus *Cecropia* is one which is also very important in the secondary succession throughout the tropical American rain forest..... The palms and cecropias soon overtop and suppress the mangroves; they may lead directly to the establishment of a várzea or Freshwater swamp forest liable to flooding. This consists of gigantic trees and is similar in general aspect to the climax Rain forest. At other times (the accounts are not quite clear about this) the succession seems to follow a different course and the *Rhizophora* community is followed by one of the palm *Raphia vinifera* var. *taedigera*. Behind the *Rhizophora* or *Raphia* belt there may be either one dominated by the tall palm *Mauritia flexuosa* growing as a pure community or intermixed with other palms such as *Euterpe oleracea, Manicaria saccifera* and *Maximiliana regia*, or a belt of Cecropietum dominated by the two species mentioned above. The trees *Virola surinamensis* and *Carapa guianensis* are characteristic of the palm and *Cecropia* belts. The reasons for these variations in the succession are not known, but whatever the course of events in the intermediate stages, várzea forest is eventually developed.

"The várzea varies much in character in different places. Its average height is from 15 to 30 m. Very characteristic is its irregular profile in which the huge dome-shaped crowns of *Ceiba pentandra* are conspicuous. Other conspicuous trees in this swamp forest are *Carapa guianensis, Hevea brasiliensis* and *H. guyanensis, Symphonia globulifera, Virola surinamensis* and many Leguminosae. Palms are frequent and where the forest reaches the water's edge there is often a fringe of *Pachira aquatica*.....

"Much less is known about the hydroseres on the lower Amazon above the delta region, though some information can be gleaned from papers by BOUILLIENNE (1930) and ULE (1908). Here the tides are smaller, but seasonal floods cause large variations in the water level. The climate is more continental than in the delta. Bordering the river there is a restinga or 'dam' formed by the deposition of the coarsest sediments; beyond it the ground is lower and more swampy. The following seral communities have been described; (i) various types of floating aquatic vegetation, including a community dominated by the giant waterlily, *Victoria amazonica* and a 'sudd' of *Echinochloa polystachya* and *Eichhornia*, (ii) campos de várzea, grassy swamps, which, like the sudd, are chiefly dominated by *Echinochloa polystachya, Hymenachne amplexicaulis* and *Paspalum repens*, (iii) a zone of the shrubs *Salix humboldtiana* and *Alchornea castaneifolia* which lines the river banks. Round the edge of the campos de várzea, forest starts abruptly. The margin of this forest is, (iv) a zone of Cecropietum formed of several species, including *C. palmata* and *C. paraensis*; it consists of groups of trees rather than a continuous belt. Each group is usually even-aged and the Cecropietum lasts for only one generation..... The succeeding community is (v) várzea forest which grows mainly on the restingas or 'dams' and so consists mainly of narrow strips. Two successional stages of várzea are recognized, young várzea, in which the chief trees are quick-growing species such

as *Calcophyllum spruceanum, Inga* spp. and *Triplaris surinamensis*, and mature várzea forest, which is similar in composition to that of the delta region, except that the most abundant palm is *Astrocaryum jauari, Mauritia* being almost absent. In the eastern part of the lower Amazon these várzea forests are strikingly less luxuriant than those of the delta, probably owing to the drier climate, but further up the river, where the climate becomes moister, they again become taller.

"ULE (1908 a) has briefly described the succession on sandbanks in the Juruá, a tributary of the upper Amazon. Here the first stage is a herbaceous marsh consisting of grasses and various other herbs. When the bank becomes higher *Salix humboldtiana* and *Alchornea castaneifolia* appear, followed by *Cecropia* spp.

"On the 'blackwater' tributaries of the Amazon....., such as the Rio Negro, the riverside vegetation, according to ULE (loc. cit.) is quite different from that of the main river and 'whitewater' tributaries, the *Cecropia* communities and some of the commonest species of the other rivers being quite absent (RICHARDS 1952)."

3) Ecology.

FITTKAU (1964; 1967) described the main features of the headwaters of the Central Amazon tributary streams from which many of his collections were made. For the most part these streams arise in springs in the nutrient poor Tertiary sediments of the terra firme. At first in the erosion zone the brooks are small and relatively steep with alternating rapids (cachoeiras) and helocrene Buriti palm (*Mauritia flexuosa*) swamps. Running under the dense shade of the rain forest, they lack minerals and light and the only food for aquatic life is organic matter (blossoms, pollen, fruits and insects) that falls or is washed in. No algae can grow here and insect and other animal life is very poor.

In mid course or sedimentation zone the stream becomes wide enough to receive some light from the sky and here it becomes a river. Usually the bed is sandy and the stream meanders over a flat valley with alternating deep and shallow water while the banks are stabilized by tree roots. For the most part these rivers are fertilized mainly by dead leaves and other organic matter from the forest which fall in the water and the lower members of the food chains are those adapted to feeding on this decomposing organic matter, true herbivores being very scarce. Many kinds of predatory insects (especially chironomids) and small fishes have evolved on this impoverished microfauna, while larger aquatic animals are very scarce (hence the term "starvation waters" – no fish).

In the lower course, called the igapó zone, the tributary streams are flooded each year by the waters of the main river system to a depth of as much as 10–15 m. For several months of the year the whole igapó forest is flooded to a depth of several meters with Amazon water forming an extremely variable and complex biotic zone. This portion of the river is a stream only in low water periods, and the remainder of the time it is a mouth-lake or reservoir filled with warm, nutrient-rich waters of the main Amazon River (FITTKAU 1971 a). The lower parts of these river lakes are fertilized annually by the Amazon floods and develop significant amounts of phytoplankton, algae, higher plants, zooplankton, insect larvae, and through the food chains to fish, turtles and caymans. Many of the Amazon fish come in large numbers into these river lakes to reproduce. Aquatic insects and their larvae, which are highly adapted to the annual fluctuation of water level and its trophic cycle, are important animal components of this community.

The lower course of the Rio Guamá near the Pará Estuary has a feature of special inte-

rest (EGLER and SCHWASSMANN 1964). At the daily change of tide, a tidal wave, bore, or pororoca, of great force enters the river mouth, especially during the equinoctal syzgy, when it may suddenly produce a water level change of as much as 4 m. The tidal wave is much stronger going upstream than in returning, and brings considerable sedimentary matter up from the bottom of the estuary and on to the flooded shores. The Guamá várzeas are thus especially enriched by admixture of estuarine water and sediments, and this may help account for the development of a rich *Culicoides* fauna in the APEG Forest.

III. Biology

1) Biting habits of Amazon *Culicoides.*

Very little work has been done on the biting habits of neotropical *Culicoides*. It was therefore especially gratifying to receive from Dr. AITKEN 40 collections of *Culicoides* taken from human bait at ground level, and at 20 and 35 m platforms in the tree canopy in the APEG Forest in Belém. The following 17 species were represented in these collections: *acotylus* (3 specimens in 3 collections), *batesi* (1 – 1), *belemensis* (18 – 9), *cylindricornis* (3 – 2), *debilipalpis* (4 – 1), *foxi* (11 – 7), *fusipalpis* (1 – 1), *gabaldoni* (1 – 1), *glabellus* (1 – 1), *ignacioi* (1 – 1), *insinuatus* (2 – 1), *lanei* (1 – 1), *paraensis* (2 – 2), *paucienfuscatus* (22 – 8), *pifanoi* (6 – 5), *pseudodiabolicus* (43 – 25), and *todatangae* (1 – 1).

2) Larval habitat

We have summarized the known larval habitats of the Amazon *Culicoides* under each species discussion. Most of this information was taken from papers by FORATTINI et al. (1958), WIRTH and BLANTON (1959), BREELAND (1960), WILLIAMS (1964), and WIRTH, WIRTH and BLANTON (1968). WILLIAMS' report on the 24 species he reared in Trinidad is the most important work on the larval habitats of neotropical *Culicoides*. He reared ten species from one habitat, decaying cacao pods.

Of the Amazon species whose larval habitat is known, the majority occur in decaying plant materials or debris in tree holes or bamboo stumps (eleven species – *debilipalpis, fluvialis, foxi, gabaldoni, glabellus, glabrior, heliconiae, hylas, paraensis, pifanoi,* and *pusillus*). Eight species are terrestrial, breeding in wet soil and stream and ditch margins (*foxi, insignis, leopoldoi, limai, paucienfuscatus, pifanoi, pseudodiabolicus,* and *reticulatus*). These habitats are not mutually exclusive, as some terrestrial species are found in the latter stages of decaying plant materials on the ground, and some species breeding in rotting plant fiber will follow that substrate into the soil as it rots down.

FITTKAU's reared Amazon material is not yet available for study, but should produce habitat records of some additional species that were common in his light trap collections. It would seem likely that *dasyophrus, foxi, paucienfuscatus, fusipalpis,* and *lutzi* breed in large numbers in the sandy stream margins where his light collections were made. *C. paucienfuscatus* was taken in large numbers in the igapós at the mouth of the igarapés or creeks in the Rio Cuieiras and Rio Taruma where the large predaceous ceratopgonids *Paryphoconus* and *Mallochohelea* were also common.

IV. Terminology

Good accounts of *Culicoides* morphology were given by FORATTINI (1957) and WIRTH and BLANTON (1959). We need mention here only the following special terms which are used in our descriptions and in our summary of numerical characters in Table 1. Wing length is measured from the basal arculus to the wing tip; costal ratio (CR) is the length of the costa measured from the basal arculus to the tip of the second radial cell (2RC) divided by the wing length. Antennal ratio (AR) is the combined length of the five elongated distal segments (in this paper the flagellomeres for convenience are called segments) divided by the combined length of the preceding eight. Sensory pattern is distribution of antennal segments bearing distal sensory tufts. Palpal ratio (PR) is the length of the third palpal segment divided by its greatest breadth. Proboscis/head ratio (P/H ratio) is the length of the proboscis measured from the distal end of the labrium-epipharynx to the anterior margin of the tormae divided by the distance measured from the latter point to the median hair socket between the eyes.

Table 1. Systematic arrangement of Amazonian *Culicoides* with mean values of certain numerical characters of females.

	Wing length (mm)	Costal ratio	Antennal ratio	Antennal sensory pattern	Palpal ratio	P/H ratio
Subgenus *Hoffmania*						
hylas Group						
aitkeni	1,50	0,70	1,26	3,11–15	6,0	1,38
heliconiae	1,46	0,68	1,06	3,11–15	3,6	1,33
hylas	1,19	0,70	1,08	3,11–15	3,4	1,15
palpalis	1,48	0,67	1,11	3,11–15	4,7	1,32
guttatus Group						
batesi	1,18	0,70	1,08	3,11–15	2,5	0,75
filariferus	1,07	0,66	1,17	3,11–15	2,8	0,88
flavivenula	1,10	0,65	1,17	3,11–15	3,7	0,91
foxi	1,21	0,68	1,10	3,11–15	3,2	1,15
fusipalpis	1,04	0,67	1,21	3,11–15	3,5	0,85
ignacioi	1,16	0,66	1,05	3,11–15	3,8	1,15
insignis	1,11	0,65	1,32	3,5,7,9,11–15	2,8	1,05
lutzi	1,22	0,70	1,18	3,11–15	1,9	0,80
paramaruim	1,13	0,66	1,23	3,11–15	2,8	0,80
pseudodiabolicus	1,03	0,67	1,14	3,11–15	3,0	0,96
travassosi	1,20	0,66	1,20	3,11–15	3,7	–
Subgenus *Avaritia*						
pusillus	0,64	0,53	1,18	3,13–15	2,6	1,08
Subgenus *Diphaeomyia*						
freitasi	0,98	0,63	1,45	3,11–15	1,9	0,59
iriartei	0,93	0,61	1,42	3,7 –10	2,0	0,65
Subgenus *Drymodesmyia*						
pilosus	0,99	0,59	1,56	3–9,11–15	2,0	0,78

	Wing length (mm)	Costal ratio	Antennal ratio	Antennal sensory pattern	Palpal ratio	P/H ratio
Subgenus *Oecacta* *limai* Group						
belemensis	1,04	0,61	1,17	3,11–14	2,5	0,90
camposi	0,96	0,59	1,18	3,7 –10	2,1	0,90
carpenteri	0,99	0,61	1,22	3,11–14	2,4	0,85
carvalhoi	1,08	0,59	0,81	3,8 –10	2,1	0,68
limai	0,80	0,63	1,06	3,7 –10	1,8	0,72
vernoni	1,00	0,62	1,22	3,8 –10	2,0	0,66
acotylus Group						
acotylus	1,05	0,70	0,78	3,6 –10	2,3	0,59
atripalpis	1,08	0,65	1,16	3,8 –10	2,7	–
carsiomelas	0,99	0,65	0,96	3,7 –10	1,8	0,74
lanei	1,02	0,66	0,72	3,7 –10	1,8	0,60
discrepans Group						
albuquerquei	1,09	0,62	1,00	3,8 –14	2,5	0,78
wallacei	1,47	0,68	0,75	3,8 –10	2,3	0,65
reticulatus Group						
bricenoi	0,99	0,69	1,70	3,8 –10	2,0	0,75
fittkaui	1,15	0,61	0,84	3,8 –10	2,4	0,63
goeldii	1,24	0,58	0,64	3,7 –10	2,9	0,75
guamai	1,12	0,62	0,96	3,8 –10	2,1	0,76
paucienfuscatus	1,02	0,63	1,18	3,7 –10	2,2	0,71
pifanoi	0,79	0,60	0,91	3,7 –10	1,8	0,72
reticulatus	0,96	0,65	1,10	3,8 –10	2,8	1,09
fluvialis Group						
antunesi	0,79	0,50	1,04	3,7 –10	1,7	0,70
eublepharus	0,98	0,64	1,43	3,11–14	2,1	0,88
fluvialis	0,78	0,61	1,07	3,8 –10	1,8	0,73
leopoldoi	0,85	0,61	1,21	3,7 –10	1,8	0,57
propriipennis	0,85	0,63	0,97	3,8 –14	1,9	0,82
rangeli	0,98	0,64	1,50	3,10–14	2,0	0,83
tetrathyris	0,85	0,70	1,09	3,8 –10	1,9	0,94
leoni Group						
fieldi	0,72	0,60	0,85	3,8 –10	1,8	0,60
glabellus	0,68	0,56	0,88	3,8 –10	1,8	0,87
debilipalpis Group						
dasyophrus	0,74	0,57	1,23	3,7 –10	1,6	0,54
debilipalpis	0,80	0,65	0,83	3,8 –10	2,2	1,00
gabaldoni	0,65	0,62	0,91	3,8 –10	1,8	0,80

	Wing length (mm)	Costal ratio	Antennal ratio	Antennal sensory pattern	Palpal ratio	P/H ratio
debilipalpis Group cont.						
ginesi	0,80	0,62	0,74	3,7 –10	2,0	0,72
glabrior	1,02	0,68	0,89	3,7 –10	1,9	0,56
guerrai	0,95	0,62	0,83	3,8 –10	2,1	0,67
insinuatus	0,72	0,63	0,78	3,8 –10	2,8	0,67
limonensis	0,84	0,57	0,90	3,8 –10	1,9	0,63
paraensis	0,78	0,59	0,77	3,8 –10	2,1	0,82
todatangae	0,88	0,58	0,90	3,8 –10	3,2	0,96
stigmalis Group						
fluviatilis	1,12	0,64	0,87	3,8 –10	2,4	0,60
pachymerus Group						
caprilesi	0,83	0,78	0,61	3,8 –10	2,0	0,73
cylindricornis	1,32	0,83	0,67	3,8 –10	3,2	0,81

V. Key to species of Amazon *Culicoides* (primarily to females)

1. Second radial cell wholly or mainly included in a pale distal spot 2
-- Second radial cell wholly included in a very dark spot (lumen of cell sometimes pale) 17
2. Cell R5 with separate pale spot present anterior to base of vein M1; base of cell M4 and adjacent veins in a dark area 3
-- Cell R5 without separate pale spot present anterior to base of vein M1; base of cell M4 pale bordering veins M3+4 (except in *cylindricornis* which has only one radial cell 6
3. Hind femur with broad subapical pale band . . . . . *aitkeni* WIRTH and BLANTON
-- Hind femur dark to tip 4
4. Mid knee pale; palpal pit absent, third segment with scattered sensilla 5
-- Mid knee with dark spot; palpus with shallow subdivided pit . . . . . *hylas* MACFIE
5. Apices of veins M1, M2, M3+4 and Cul pale . . . . . *heliconiae* FOX and HOFFMAN
-- Apices of veins M1 and M2 pale, M3+4 and Cul dark. . . . . *palpalis* MACFIE
6. One radial cell present, costa long, CR 0,83; antennal sensory pattern 3, 8–10 . . . . . *cylindricornis* n. sp.
-- Two radial cells present; costa shorter, CR 0,64–0,70; antennal sensory pattern 3, 11–15, occasionally also on 5,7,9 7
7. Cell M1 with two pale spots distal to double pale spot straddling vein M2; palpal pit with regular margins present; r–m crossvein infuscated 8
-- Cell M1 with only one pale spot distal to double spot straddling vein M2; palpal pit irregular or absent; r–m crossvein not infuscated 12
8. Small black spot present on vein R4+5 near end of 2RC; halter knob dark; larger species, wing 1,2 mm long 9
-- No small black spot on vein R4+5 near end of 2RC; halter knob pale or dark; small or large species 10

9. Cell R5 with two pale spots past the poststigmatic pale spot, the distal one lying in extreme apex of cell . . . . . *travassosi* FORATTINI
-- Cell R5 with only one pale spot lying past poststigmatic pale spot . . . . . *foxi* ORTIZ
10. Anterior end of r–m crossvein blackened 10
-- Crossvein r–m not infuscated . . . . . *filariferus* HOFFMAN
11. Larger species, wing usually over 1,1 mm long; halter deeply infuscated; wing markings contrasting . . . . . *ignacioi* FORATTINI
-- Smaller species, wing usually less than 1,1 mm long; halter pale or slightly infuscated; wing markings poorly contrasting . . . . . *pseudodiabolicus* FOX
12. (7). Vein R4+5 blackened into adjacent distal pale area up to a point where vein turns abruptly forward to meet costa; antennal sensory pattern 3,5,7,9,11–15; third palpal segment with definite, irregular sensory pit . . . . . *insignis* LUTZ
-- Vein R4+5 not blackened into adjacent distal pale area; antennal sensory pattern 3, 11–15; palpal pit various or absent 13
13. Third palpal segment with definite round pit . . . . . *flavivenula* COSTA LIMA
-- Third palpal segment with pit irregular or absent 14
14. Third palpal segment with definite, irregular, sensory pit 15
-- Third palpal segment without sensory pit, sensilla scattered on surface 16
15. Halter pale; distal portion of vein M3+4 pale; wing markings contrasting . . . . . *lutzi* COSTA LIMA
-- Halter dark; distal portion of vein M3+4 dark; wing markings dull, diffuse . . . . . *batesi* n. sp.
16. Wing pattern diffuse, dark, not contrasting; halter dark; legs with indistinct pale band . . . . . *paramaruim* n. sp.
-- Wing pattern of definite, extensive, contrasting pale spots; halter pale; legs with distinct pale bands . . . . . *fusipalpis* n. sp.
17. (1). Pale spots at periphery of wing faint or absent 18
-- Pale spots at periphery of wing well defined 20
18. Small species, wing 0,64 mm long; wing practically without macrotrichia; 2RC short, as broad as long, CR 0,53; legs yellowish except for dark knee spot. . . . . *pusillus* LUTZ
-- Larger species, wing 0,90–1,30 mm long; wing with more abundant macrotrichia; 2RC longer, CR 0,60–0,70; legs dark 19
19. Second radial cell with broad lumen, about three times as long as broad; CR 0,64; third palpal segment with broad shallow pit; wing macrotrichia spiculate. . . *fluviatilis* LUTZ
-- Second radial cell with small lumen, about twice as long as broad; CR 0,61; third palpal segment with small round shallow pit; wing macrotrichia fine . . . . *belemensis* n. sp.
20. (17).Wing with pale spot straddling middle of vein M2 or veins M1 and M2 entirely pale margined including this area. 21
-- Wing with no pale spot straddling vein M2, this vein usually dark to apex 32
21. Wing dark with well separated pale spots 22
-- Wing with pale markings extensive, interconnected 27
22. Vein M1 with pale spot straddling midportion; mesonotum dark brown anteriorly, with submedian anterior spots and entire posterior half contrasting yellowish; antennal sensory pattern 3, 7–10. . . . . *camposi* ORTIZ and LEON
-- Vein M1 without pale spot straddling midportion, at most a small pale spot in cell R5 lying adjacent to basal portion of vein; mesonotal pattern not as above; antennal sensory pattern 3, 11–15, 3–9, 11–15, or 3, 8–10. 23
23. Cell R5 with one or two pale spots lying adjacent to basal portion of vein M1; distal pale spot in cell M1 not reaching wing margin 24
-- Cell R5 without pale spot lying adjacent to basal portion of vein M1. 25
24. Two pale spots in cell R5 lying adjacent to anterior side of vein M1; antennal sensory pattern 3, 7–10; third palpal segment with broad, shallow sensory pit . . . . . *iriartei* FOX
-- One pale spot in cell R5 lying adjacent to anterior side of vein M1; antennal sensory pattern 3, 11–15; third palpal segment with small deep sensory pit. . . . . *freitasi* n. sp.

25. Crossvein r–m pale; cell R5 with two pale spots 26
-- Crossvein r–m infuscated forming a dark center to the pale spot covering this area; cell R5 with four pale spots (antennal sensory pattern 3, 8–10; palpal pit shallow) . . . . . *atripalpis* n. sp.
26. Antennal sensory pattern 3, 11–14; palpal pit shallow; wing sparsely hairy, paler with indistinct spots. . . . . *carpenteri* WIRTH and BLANTON
-- Antennal sensory pattern 3–15; palpal pit deep and opening by a smaller pore; wing densely hairy, dark with distinct pale spots. . . . . *pilosus* WIRTH and BLANTON
27. (21). Mesonotum without prominent pattern or pattern consisting of large pale patches . . . 28
-- Mesonotum with prominent pattern of small brown punctiform dots. 30
28. Mesonotum uniformly grayish pollinose, without prominent pattern; cell R5 with distal pale spot extending along anterior side of vein M1 to distal wing margin; anal cell with two pale spots in distal portion; male parameres nearly straight on basal and midportions with abrupt bend at the prominent ventral lobe. . . . . *carvalhoi* n. sp.
-- Mesonotum with prominent pattern of large yellowish to grayish patches; cell R5 with distal pale spot separated from apical wing margin by a dark area; anal cell with one or two pale spots in distal portion. 29
29. Cell M1 with distal pale spot shorter than dark area between it and wing margin; cell R5 with poststigmatic pale spot not enclosing a dark spot behind 2RC; mesonotum yellowish with dark brown sublateral bands; anal cell with two distal pale spots . . . . . *pifanoi* ORTIZ
-- Cell M1 with distal pale spot longer than dark area between it and wing margin; poststigmatic pale spot in cell R5 U-shaped, enclosing a small dark spot behind 2RC; mesonotum grayish pruinose with three narrow dark longitudinal lines; anal cell with one continuous distal pale area . . . . . *paucienfuscatus* BARBOSA
30. (27). Halter intensely dark; 2RC with pale lumen but short; cell R5 with separate small dark spot lying behind base of 2RC separated from dark area on base of medial fork; pale areas of wing whitish; aedeagus with conspicuously spiculate slender tip . . . . . *goeldii* n. sp.
-- Halter pale or only slightly infuscated; 2RC variable; cell R5 with dark spot behind 2RC continuous with dark area on base of medial fork; pale areas of wing with yellowish tint; aedeagus without spicules on tip 30
31. Second radial cell elongate with lumen conspicuously paler . . . . . *fittkaui* n. sp.
-- Second radial shorter without paler lumen. . . . . *guamai* n. sp.
32. (20). Cell M1 with three pale spots 33
-- Cell M1 with two pale spots 35
33. Cell R5 with four small round pale spots arranged in a rhomboid in midregion; no small pale spot at apex of cell R5; anal cell with two distal pale spots; mesonotum with prominent pattern; halter knob brown . . . . . *propriipennis* MACFIE
-- Cell R5 with a small round pale spot at apex, as well as other proximal pale spots 34
34. Cell R5 with subapical pale spot round or reniform, not attaining wing margin; a pale spot at end of 2RC; anal cell with one distal pale spot; mesonotum without prominent pattern . . . . . *paraensis* (GOELDI)
-- Cell R5 with subapical pale spot irregular, usually extending to anterior wing margin; three small round pale spots beyond and behind second radial cell; anal cell with two distal pale spots; mesonotum with prominent pattern . . . . . *lanei* ORTIZ
35. (32). Cell M2 with two pale spots lying distal to level of mediocubital fork 36
-- Cell M2 with one pale spot lying distal to level of mediocubital fork not counting any spot not lying immediately anterior to base of fork 48
36. Distal pale spot in cell M1 broadly meeting wing margin; cell R5 with apex nearly or entirely filled with a large pale area; two spermathecae present 37
-- Distal pale spot in cell M1 not reaching wing margin; spermathecae various 39
37. Femora stout; anal cell with one definite pale spot located far from wing margin; mesonotum uniformly pruinose brown, without prominent pattern; second radial cell long with braod lumen, CR 0,78; distal antennal segments short, AR 0,61 . . . . . *caprilesi* FOX

-- Femora slender; anal cell with two more or less coalesced pale spots, the posterior one broadly meeting margin; mesonotum with prominent pattern of large yellowish patches, second radial cell not unusually long, CR 0,62–0,63; distal antennal segments elongate, AR 1,06–1,22 38

38. Distal pale spot in cell R5 rounded distally leaving a small dark mark in apex of cell; hind femur with subapical pale band . . . . . *limai* BARRETTO

-- Distal pale spot in cell R5 extending to apex of cell in full posterior breadth; hind femur dark to tip . . . . . *vernoni* n. sp.

39. (36). Anal cell with one pale spot in distal portion 40

-- Anal cell with two pale spots in distal portion 42

40. Two sclerotized spermathecae present; apices of veins M1 and M2 each with pale spot at wing margin 41

-- Spermathecae unsclerotized; apices of veins M1 and M2 dark at wing margin . . . . . *antunesi* FORATTINI

41. Cell R5 with distal pale spot in form of an oblique double spot broadly meeting wing margin anteriorly; r–m crossvein pale; mesonotal pattern of large pale and dark patches . . . . . *fluvialis* MACFIE

-- Cell R5 with distal pale spot rounded with narrower pale extension barely attaining wing margin anteriorly; r–m crossvein with a prominent dark spot; mesonotum rusty red, without prominent pattern . . . . . *carsiomelas* WIRTH and BLANTON

42. Mesonotum without prominent pattern; antennal sensory pattern 3, 10–14 or 3, 11–14; one spermatheca present 43

-- Mesonotum with prominent pattern; antennal sensory pattern 3, (7), 8–10 or 3, 8–14; one or two spermathecae present 44

43. Palpus with definite round pit; sensory pattern 3, 11–14; AR 1,43; male parameres without strong lobe in midportion . . . . . *eublepharus* MACFIE

-- Palpus with irregular pit; sensory pattern 3, 10–14; AR 1,63; male parameres with strong swelling on midportion . . . . . *rangeli* ORTIZ and MIRSA

44. Two spermathecae present; mesonotum with pattern of large yellowish spots not containing brown punctiform dots; larger species, wing 0,96–1,47 mm long 45

-- One spermatheca present; mesonotum with large yellowish spots, some containing a brown punctiform dot; small species, wing 0,85 mm long; antennal sensory pattern 3, 7–10 . . . . . *leopoldoi* ORTIZ

45. Pale spot over r–m crossvein divided into two separate pale spots by a dark line across anterior end of crossvein; palpal pit subdivided to form a double sensory pit; two widely separated pale spots in distal portion of cell R5 . . . . . *reticulatus* LUTZ

-- One undivided pale spot over r–m crossvein; palpal pit round, not subdivided; one pale spot, sometimes appearing double, in distal portion of cell R5 46

46. Poststigmatic pale spots in cell R5 in form of an irregular U-shaped area enclosing a small round dark spot behind 2RC; antennal sensory pattern 3, 8–10 47

-- Only two small distinct poststigmatic pale spots in cell R5; antennal sensory pattern 3, 8–14 . . . . . *albuquerquei* n. sp.

47. Second radial cell at leasr four times as long as broad; apices of veins M1, M2, and M3+4 pale at wing margin. . . . . *bricenoi* ORTIZ

-- Second radial cell not more than twice as long as broad; apex of only vein M1 pale at wing margin . . . . . *wallacei* n. sp.

48. (35). Cell R5 with three pale spots; crossvein r–m not blackened; palpus with definite pit 48

-- Cell R5 with five pale spots; crossvein r–m dark and lying entirely within a pale spot; palpus with scattered sensilla. . . . . *acotylus* LUTZ

49. One functional spermatheca present 50

-- Two functional spermathecae present 53

50. Antennal segment 11 equal to or longer than 10; larger species, wing 0,74–0,95 mm long 51

-- Antennal segment 11 shorter than 10; smaller species, wing 0,65 mm long 52

51. Distal antennal segments elongated, AR 1,23; sensory pattern 3, 7–10; halter pale; smaller species, wing 0,74 mm long; aedeagus with slender distal process flanked by short hyaline lobes; parameres slightly situate with distal fringing spines . . . . . *dasyophrus* MACFIE

-- All antennal segments elongate, in continuous series, AR 0,83; antennal sensory pattern 3, 8–10; halter dark; larger species, wing 0,95 mm long; distal process of aedeagus with subparallel sides, with three sharp apical points and a pair of sharp subapical points; parameres contorted distally without distal fringing spines . . . . . *guerrai* WIRTH and BLANTON

52. Halter pale; wing broader; poststigmatic pale spots in cell R5 usually fused and extending nearly to vein M1, the posterior portion at same level with or extending slightly distal of anterior part; macrotrichia present on extreme apex of wing; male genitalia without ventral lobe on paramere . . . . . *glabellus* WIRTH and BLANTON

-- Halter brownish; wing not unusually broad; poststigmatic pale spots in cell R5 usually small and distinctly separated, the posterior one located slightly proximad of anterior spot; macrotrichia present on distal third of wing; male genitalia with well developed ventral lobe on paramere . . . . . *fieldi* WIRTH and BLANTON

53. (49). Mesonotum with prominent pattern of punctiform brown dots; three small round equidistant pale spots in a triangle in cell R5: halter knob dark at base; eyes bare; antennal segments in continuous series . . . . . *ginesi* ORTIZ

-- Mesonotum with prominent pattern of large pale patches or without prominent pattern; distal pale spots in cell R5 not in equilateral triangle 54

54. Anal cell with two distal pale spots; cell R5 with four small round pale spots arranged in a rhomboid in midregion . . . . . *tetrathyris* WIRTH and BLANTON

-- Anal cell with one distal pale spot; cell R5 with two or three pale spots in midregion 55

55. Palpus pale yellow; small species, wing 0,65 mm long; antennal segment 11 shorter than 10; male genitalia with stem of paramere gradually tapering to fine tip, no ventral lobe or distal ringing spines . . . . . *gabaldoni* ORTIZ

-- Palpus not pale yellow; larger species, wing 0,7–1,4 mm long; antennal segment 11 subequal to or longer than 10 56

56. Second radial cell unusually broad; pale spot at end of costa well separated from spot behind 2RC, farther from it than from the distal pale spot in cell R5, which is narrow and transverse; pale distal spot in anal cell elongated, extending nearly to wing margin; eyes bare; halter brown; larger species, wing 1,02 mm long; aedeagus with slender distal process bearing deep distal fork . . . . . *glabrior* MACFIE

-- Second radial cell not unusually broad. 57

57. Pale spot present in cell M2 lying adjacent to midportion of mediocubital stem 58

-- No pale spot present in cell M2 lying adjacent to midportion of mediocubital stem 59

58. Pale spot present in front of mediocubital fork . . . . . *insinuatus* ORTIZ and LEON

-- Pale spot absent in front of mediocubital fork. . . . . *todatangae* n. sp.

59. Distal pale spot in cell M1 extending to wing margin; third palpal segment short and broad; antennal segments short and stout . . . . . *limonensis* ORTIZ and LEON

-- Distal pale spot in cell M1 lying far from wing margin; third palpal segment long and slender, PR 2,2, with small deep pit; antennal segments slender . . . . . *debilipalpis* LUTZ

VI. Description of species

1.) *Culicoides acotylus* LUTZ

Culicoides acotylus LUTZ, 1913: 69 (female; Brazil; figure wing, palpus); FORATTINI, 1957: 445 (redescribed; figures); WIRTH and BLANTON, 1959: 367 (redescribed; figures).

Distribution.- - Brazil, Mexico, Panama, Trinidad, Venezuela.
Type Locality.- - Salto Augusto, Rio Tapajós, Mato Grosso, Brazil.
Amazon records.- -
BRAZIL: Belém, Pará, APEG Forest, III, VII, VIII, IX, XI, 1969–70, AITKEN, light trap in terra firme, 3 males, 4 females.

Biting records.- - AITKEN took 3 females biting man at 0100 hours on 20 and 35 m platforms in the canopy of the APEG Forest in November and December 1970.

2.) *Culicoides aitkeni* WIRTH and BLANTON

Culicoides aitkeni WIRTH and BLANTON, 1968a: 214 (female; Trinidad; figures).

Distribution.- - Brazil, Trinidad.
Type Locality.- - Macqueripe Naval Station, Trinidad.
Amazon records.- -
BRAZIL: Belém, Pará, APEG Forest, II, III, IV, 1969–70, AITKEN, light trap in terra firme, 5 females.

3.) *Culicoides albuquerquei* WIRTH and BLANTON, new species.
Plate 1.

Female.- - Wing length 1,09 mm.

Head: Eyes (Plate 1d) nearly contiguous, bare. Antennae (Plate 1a) with lengths of flagellar segments in proportion of 33-30-30-30-30-30-30-30-40-40-43-50-72; AR 1,00; sensory pattern 3, 8–14, sometimes also on 6 and 7, rarely absent on 10. Palpal segments (Plate 1b) with lengths in proportion of 10-30-45-18-19; PR 2,50; third segment moderately slender with shallow, round, sensory pit. Proboscis moderately long, P/H ratio 0,78; mandible with 15 teeth.

Thorax: Dark brown; mesonotum (Plate 1g) with prominent pattern of large yellowish patches. Legs (Plate 1h) dark brown; knee spots blackish; femora with subapical and tibiae with sub-basal, narrow pale rings; hind tibia with apex broadly pale; tibial comb (Plate 1e) with four spines, the second from the spur the longest.

Wing (Plate 1c): Pattern as figured; microtrichia coarse, giving wing a dark brown ground color, three areas along anterior margin even darker; only a small pale spot at wing base, not extending into anal cell; pale spot over r–m crossvein small, extending from costal margin to vein M; cell R5 with two separate, small, poststigmatic pale spots, posterior one lying behind second radial cell about halfway between it and vein M1; an oblique double pale spot in distal part of cell R5, broadly meeting wing margin; cell M1 with two small oval pale spots, the distal one lying apart from wing margin; cell M2 with a double pale spot lying between medial and mediocubital forks, and two pale spots in distal portion, the apical one meeting wing margin; cell M4 with round pale spot in distal portion, with a broader anterior extension toward vein M3+4; anal cell with two small round pale spots in distal portion; vein M1 with tip pale at wing margin. Macrotrichia sparse but coarse, extending nearly to base of anal cell; radial cells with distinct lumens; CR 0,62. Halter infuscated.

Abdomen: Dark brown; spermathecae (Plate 1f) two plus rudimentary third and sclerotized ring; short oval with short slender necks, subequal, each measuring 0,045 by 0,033 mm.

Male.- - Similar to female with usual sexual differences; antenna with long brown plume; last three segments with lengths in proportion of 78-66-80, sensory pattern 3, 13–14. Genitalia (Plate 1j): Ninth sternum with deep caudomedian excavation, ventral membrane not spiculate; ninth tergum distinctly tapering, with moderately approximated, long, slender, subparallel, apicolateral processes. Basistyle moderately stout, with large angular ventral root, the "toe" stout and "heel" reduced; dorsal root slender; dististyle slender, slightly curved with bent, pointed tip. Aedeagus with basal arch extending to half of total length, basal arms moderately stout; distal process broad, bearing a subapical pair of dorsally directed

lobes on lateral margins, distally produced in a pair of filamentous points with a median semi-oval emargination. Parameres (Plate 1i) each with dark basal knob, stem long and slender, bent near base, slightly sinuate in midportion, without ventral lobe; distally abruptly bent ventrad and mesad, tapering to a point with lateral fringing spines.

Distribution.- - Brazil.

Types.- - Holotype, female, Belém, Pará, Brazil, December 1969. T.H.G. AITKEN, light trap in APEG Forest, terra firme, 32 m in tree canopy. Allotype, male, same data except date August 1970. Paratypes, 1 male, 7 females, same data except dates February to November 1969, 1970.

Discussion.- - This species is named in honour of Dr. DALCY de O. ALBUQUERQUE, Museu Nacional, Rio de Janeiro, and formerly director of the Museu Paraense in Belém, our esteemed friend and accomplished dipterist.

In wing pattern, *C. albuquerquei* is similar to *C. discrepans* ORTIZ and MIRSA and *C. avilaensis* ORTIZ and MIRSA from Venezuela, but both related species have a single, undivided poststigmatic pale spot in cell R5 and the base of the wing is extensively pale. Both these species have the hind femur with distal pale band, but the antennal sensorial pattern is 3, 8–10, thus resembling *wallacei* n. sp.

4.) *Culicoides antunesi* FORATTINI

Culicoides antunesi FORATTINI, 1954: 315 (male, female; Brazil; figures).

Distribution.- - Brazil.
Type Locality.- - Aruana, Estado Goiaz, Brazil.
Amazon records.- -
BRAZIL: Amazonas, Rio Tocantins, 5 November 1960, FITTKAU (A50), at light in house on Rio Impex, 2 males, 5 females.

5.) *Culicoides atripalpis* WIRTH and BLANTON, new species.
Plate 2.

Female.- - Wing length 1,08 mm.

Head: Eyes (Plate 2d) narrowly separated, bare. Antenna (Plate 2a) with lengths of flagellar segments in proportion of 35-30-30-30-30-32-32-34-50-50-50-50-94; AR 1,16; sensory pattern 3, 8–10; proximal ends of segments pale yellow. Palpus (Plate 2c) conspicuously blackish, second and third segments stout, subcylindrical, with strong, dense, blackish setae; third segment with small round distal sensory pit; proportions of segments 10-45-55-21-18; PR 2,75. Proboscis moderately short, proportions could not be measured; mandible with 15 teeth.

Thorax: Dark brown, mesonotum with conspicuous pattern of large yellowish patches. Legs (Plate 2f) dark brown, knee spots blackish; fore and mid femora with subapical, all tibiae with sub-basal, and hind tibia with apical, narrow plae rings; tibial comb (Plate 2g) with four spines, the one nearest the spur longest.

Wing (Plate 2b): Pattern as figured; wing deeply infuscated with dense, coarse, blackish microtrichia, pattern of definite small spots; pale spot over r–m crossvein enclosing a small dark spot on the crossvein itself; cell R5 with four small round spots, one at wing margin past end of costa, and three in a longitudinal line along midbreadth of cell, the middle spot lying almost directly behind the anterior one; cell M1 with one pale spot lying near but separate from wing margin; a large pale spot with diffuse margins straddling proximal portion of vein M2; cell M2 with pale spots behind medial fork and in front of mediocubital fork and a round pale spot in apex of cell near wing margin; cell M4 with a small round pale spot in midportion and a pale streak lying adjacent to vein M3+4 just distad; anal cell with two round pale spots in distal portion; vein M1 with a pale streak at level of the pale spot straddling vein M2. Macrotrichia sparse, confined to distal third of wing; first radial cell obsolete, not even a slit remaining; second with distinct lumen; CR 0,65. Halter pale.

Abdomen: Dark brown; spermathecae (Plate 2e) two plus rudimentary third and sclerotized ring; oviod with short slender necks, unequal, measuring 0,052 by 0,036 mm and 0,040 by 0,029 mm.

Male.- - Unknown

Distribution.- - Brazil.

Type.- - Holotype, female, Belém, Pará, Brazil, February 1969. T.H.G. AITKEN, light trap in APEG Forest, várzea, 15 m in tree canopy.

Discussion.- - This species is readily recognized by its unusual wing pattern and the stout blackish palpi. Without the male sex it is difficult to locate its near relatives, but it appears to belong to the *acotylus* group.

6.) *Culicoides batesi* WIRTH and BLANTON, new species.
Plate 3.

Female.- - Wing length 1,18 mm.

Head: Eyes (Plate 3c) contiguous, bare. Antenna (Plate 3a) with lengths of flagellar segments in proportion of 25-28-29-30-30-30-30-30-41-41-50-55-75; AR 1,08; sensory pattern 3, 11–15. Palpal segments (Plate 3b) with lengths in proportion of 12-35-47-17-21; PR 2,5; third segment moderately swollen with sensilla borne in a large irregular sensory pit. Proboscis moderately long, P/H ratio 0,75; mandible with 16 teeth.

Thorax: Dark brown; mesonotum without conspicuous pattern. Legs (Plate 3g) dark brown; mid femur pale at tip, all tibiae with narrow basal and hind tibia with narrow apical, pale rings; hind tibial comb (Plate 3f) with five spines, the second from spur longest.

Wing (Plate 3e): Pattern as figured; general colour dark smoky brown with pattern of rather indistinct pale grayish spots; base of wing broadly pale; three dark areas along anterior margin not prominent; pale spot over r–m crossvein broadly meeting costal margin; pale spot covering distal 0,6 of 2RC not large, appearing obliquely quadrate, penetrated proximally by a moderately strong dark line following vein R4+5 partway to its anterior bend; distal pale spot in cell R5 not or only indistinctly meeting anterior wing margin; pale spot straddling midportion of vein M2 penetrated by a narrow dark line along vein, the part lying in cell M2 much smaller than that lying ahead of vein M2; only one distal pale spot in cell M1, lying distant from wing margin; cell M2 pale at base, with prominent pale area between medial and mediocubital forks, and a large pale spot lying at wing margin in apex of cell; cell M4 with pale spot at wing margin toward apex of cell, usually continuous anteriorly with a broad pale line following vein M3+4 to base of fork and extending along vein Cul to half its length; anal cell with two pale spots in distal portion. Macrotrichia long and coarse, moderately numerous on distal third of wing; radial cells distinct, first slitlike, second with broad lumen; CR 0,70. Halter deeply infuscated.

Abdomen: Dark brown. Spermathecae (Plate 3d) two plus rudimentary third and sclerotized ring; ovoid with short slender necks; slightly unequal, measuring 0,058 by 0,041 mm and 0,051 by 0,038 mm.

Male.- - Similar to female, with usual sexual differences; antenna with long brown plume; last three segments with lengths in proportion of 70-60-80; sensory pattern 3, 13–15. Genitalia (Plate 3i): Ninth sternum with shallow V-shaped caudomedian excavation, ventral membrane not spiculate; ninth tergum rounded caudad, with widely spaced, prominent, apicolateral processes, the caudal margin between them transverse. Basistyle moderately stout, mesal margin with sparse, small spinules; dististyle curved, slender distally, with bluntly pointed tip. Aedeagus with basal arch low and broad, extending to a sixth of total length, with strong transverse sclerotization; sides markedly convex proximally, distal portion slender with subspherical tip; distinct internal sclerotized peg present. Parameres (Plate 3h) joined narrowly at extreme bases, each stout proximally, without distinct anterior process, tapering abruptly at wrinkled midportion to narrow distal filaments bearing distinct terminal fringing hairs.

Distribution.- - Brazil.

Types.- - Holotype, female, allotype, male, Belém, Pará, Brazil, June 1969, T.H.G. AITKEN, APEG Forest light trap. Paratypes, 2 males, 150 females, same data but dates January to November 1969–70; 1 female, APEG Forest, terra firme, 20 m platform in tree canopy, AITKEN, biting man at 1900 hours, July 1970; 2 females, Utinga Forest, Belém, 29 April 1969, T.H.G. AITKEN, light trap.

Discussion.- - *Culicoides lutzi* COSTA LIMA from Brazil is very similar structurally to *batesi* but has pale halteres, the wing markings are contrasting, and the pale lines along posterior side of vein M3+4 extends to the wing margin. In *lutzi,* like *batesi,* there is no trace of a second pale spot near the wing margin in cell M1. In *fusipalpis* n. sp. in which the wing markings are also more definite, there is sometimes, but

rarely, a trace of a second pale spot at the wing margin in the tip of cell M1, there is no palpal pit, and the halter is pale.

This species is named in honour of HENRY W. BATES, pioneer naturalist explorer of the Amazon valley, who collected at Belém for a long period of time in its early days and brought us in his "Naturalist on the River Amazon" a vivid account of its natural history.

This species was not recognized until the May 1969 collections at the end of the wet season. Then it was abundant especially in várzea collections and in far greater numbers in the tree canopy.

7.) *Culicoides belemensis* WIRTH and BLANTON, new species.
Plate 4.

Female.- - Wing length 1,04 mm.

Head: Eyes (Plate 4c) narrowly separated, bare. Antenna (Plate 4a) with lengths of flagellar segments in proportion of 34-25-25-26-27-26-25-25-40-40-46-54-70; sensory pattern 3, 11–14. Palpal segments (Plate 4b) with lengths in proportion of 13-40-38-16-14; PR 2,50; third segment only slightly swollen with small, round, shallow, sensory pit on distal third. Proboscis long, P/H ratio 0,90; mandible with 13–15 rather large teeth.

Thorax: Brownish; mesonotum tawny brown with pattern of three narrow dark brown vittae, a median anterior one and a pair of lateral ones extending nearly to scutellum. Legs (Plate 4g) brownish, knee spots blackish; tibiae with narrow basal pale rings; hind tibial comb (Plate 4d) with four spines, the one nearest the spur longest.

Wing (Plate 4e): Relatively long and narrow; markings usually obscure, specimen figured has extreme development of pale markings; 2RC dark to tip; spot in cell R5 small, oblique, not reaching vein M1; distal pale spot in cell R5 centered in distal portion of cell, not reaching margin nor cell M1, usually faint; two faint pale spots in cell M1, distal one not reaching wing margin; cell M2 with at most a pale streak it streak its entire length, except for small, round, faint, pale spot at wing margin; cell M4 with large pale spot in distal portion; anal cell with faint pale spot in distal portion. Macrotrichia scanty, confined to distal third of wing; radial cells with distinct lumens; CR 0,61. Halter brownish.

Abdomen: Pale brownish, last three segments more deeply sclerotized, brownish. Spermathecae (Plate 4f) two plus rudimentary third and ring; ovoid with long, slender necks; unequal, measuring 0,058 by 0,038 mm and 0,051 by 0,033 mm.

Male.- - Similar to the female, with usual sexual differences; antenna with long brown plume; last three segments with lengths in proportion of 70-60-76; sensory pattern 3, 11–14. Genitalia (Plate 4i): Ninth sternum with shallow caudomedian excavation, ventral membrane not spiculate; ninth tergum long and tapering, with moderately long, pointed, apicolateral processes. Basistyle moderately stout, ventral root "foot-shaped", with long hooked "heel" and toes approximated on midline; dorsal root long and slender, slightly curved, with blunt, bent, tip. Aedeagus with basal arch extending to 0,6 of total length, basal arms slender, slightly bent; distimedian process moderately slender with parallel sides and blunt, concaved tip. Parameres (Plate 4h) each with blackish basal knob; stem moderately stout and sinuate, with distinct ventral swelling ending in a distal lobe; apical portion slender, bearing lateral spines and terminating in a filiform tip.

Distribution.- - Brazil.

Types.- - Holotype, female, allotype, male, Belém, Pará, Brazil, September 1969, T.H.G. AITKEN, light trap in APEG Forest. Paratypes, 214 females, as follows: BRAZIL: same data as types, but dates January to December 1969–1970, 192 females; APEG Forest, Belém, VII, XI, XII, AITKEN, biting man at 1900–0400 hours on 20 and 35 m platforms in tree canopy, terra firme, 18 females. Rio Parú de Oeste, Pará, 26 March, 4 April 1962, E.J. FITTKAU (A361) (364) at light, 3 females. Rio Cuieiras, Amazonas, 19 December 1961, FITTKAU (A 304) at light, 6 females.

Discussion.- - This species is closely related to *C. carpenteri* WIRTH and BLANTON from Panama, but *carpenteri* has a distinct wing pattern, pale halter, and prominent pale basal and subapical bands on the femora. *Culicoides lopesi* BARRETTO from Southern Brazil has a similar wing pattern, but with the markings more distinct, but differs greatly in the antennal sensory pattern 3, 7–10, the third palpal segment stouter with a deeper pit, and in the lesser development of the ventral lobe on the male parameres.

Culicoides belemensis was found in small to moderate numbers the entire year, slightly more in

várzea collections than in terra firme, nearly equal at ground level or canopy.

8.) *Culicoides bricenoi* ORTIZ
Plate 5.

Culicoides bricenoi ORTIZ, 1951b: 445 (male; Venezuela; figure wing, palpus, genitalia); FORATTINI, 1957: 348 (redescribed; figures).

Distribution.- - Bolivia, Brazil, Ecuador, Venezuela.
Type Locality.- - Ocumare del Tuy, Miranda, Venezuela.
Amazon records.- -
BRAZIL: Belém, Pará, APEG Forest, I, VI, VII, IX, X 1968–1970, AITKEN, light trap in terra firme, 6 females. Rio Cuieiras, Amazonas, Igarapé Cachoeira, 15 April 1961, FITTKAU (A151), at light, 1 male. Rio Cuieiras, Amazonas, Rio Branquinho, 23 April 1961, FITTKAU (A169), at light, 1 male, 1 female. Rio Cururú. Pará, Mission Cururú, 14 January 1961, FITTKAU (A88), at light, 1 male, 1 female. Rio Maruaiá, Amazonas, 21 January 1963, Mission S. Antônio, FITTKAU (A484), at light, 1 female. Rio Maruaiá, end of long cachoeira, stream falling out of hills, 24, 28 January 1963, FITTKAU (A496), at light, 1 male, 1 female. Rio Negro, Amazonas, Igarapé Barro Branco, 8 May 1961, FITTKAU (A175), at light, 1 male. Rio Parú de Oeste, Pará, Mission Tiriyós, 22 March 1962, FITTKAU (A361), at light, 1 female.

Remarks.- - FITTKAU's collections indicate that *C. bricenoi* may be a terra firme species breeding beside small streams with strong gradient. The characters of the female are illustrated in Plate 5.

9.) *Culicoides camposi* ORTIZ and LEON
Culicoides camposi ORTIZ and LEON, 1955: 580 (female; Ecuador; figure wing, mesonotum, palpus, antenna). WIRTH and BLANTON,1959: 356 (redescribed; figures).
Culicoides fairchildi WIRTH and BLANTON, 1955: 103 (male, female; Panama; figures).

Distribution.- - Columbia, Ecuador, Panama.
Type Locality.- - Zapallo Grande, San Miguel de los Colorados, Pichincha Prov., Ecuador.
Amazon records.- -
COLOMBIA: Puerto Leguizamo, Putumayo, 25 June 1968, C.J. MARINKELLE, light trap, 5 females.

10.) *Culicoides caprilesi* FOX
Culicoides caprilesi FOX, 1952: 364 (female; Venezuela; figures). WIRTH and BLANTON, 1959: (redescribed; figures).
Culicoides kintzi WIRTH and BLANTON, 1953: 72 (male, female; Panama; figures).

Distribution.- - Brazil, Colombia, Panama, Venezuela.
Type Locality.- - Mt. Marahuaca, Venezuela.
Amazon records.- -
COLOMBIA: Mitú, Vaupes, 1 January 1968, C.J. MARINKELLE, biting man, 2 females.

Remarks.- - Dr. MARINKELLE informs us (in Litt.) that the Indians in the area at Mitú, Vaupes, where the *caprilesi* specimens were collected showed a 96% infection rate with *Mansonella ozzardi.* In five months only two *Culicoides* were collected but Simuliidae could be collected by the thpusands. Approximately 1 000 Simuliidae collected at the same place were dissected but no microfilariae were found.

In the USNM collection there is a long series of specimens taken at km 260, Xavantine-Cachimbo Road, Serro do Roncador, Mato Grosso, Brazil, November-December 1967 by B.E. FREEMAN.

11.) *Culicoides carpenteri* WIRTH and BLANTON
Culicoides carpenteri WIRTH and BLANTON, 1953: 72 (male, female; Panama; figures).

Distribution.- - Panama, Bolivia, Brazil.
Type Locality.- - Madden Dam, Canal Zone, Panama.
Amazon records.- -
BRAZIL: Rio Solimões, Amazonas, Fonte Boa, 2 September 1961, FITTKAU (A254), at light, 1 female.

12.) *Culicoides carsiomelas* WIRTH and BLANTON
Culicoides carsiomelas WIRTH and BLANTON, 1955: 100 (male, female; Panama; Figures).
WIRTH and BLANTON, 1959: 365 (redescribed; figures).

Distribution.- - Brazil, Colombia, Panama.
Type Locality.- - Mojinga Swamp, C.Z., Panama.
Amazon records.- -
BRAZIL: Belém, Pará, APEG Forest, I, VIII, IX, XI 1970, AITKEN, light trap in terra firme, 4 females. Rio Cururu, Pará, Mission Cururú, 19 January 1961, FITTKAU (A88), at light, 1 male.

13.) *Culicoides carvalhoi* WIRTH and BLANTON, new species.
Plate 6.

Female.- - Wing length 1,08 mm.

Head: Eyes (Plate 6b) narrowly separated, bare. Antenna (Plate 6a) with lengths of flagellar segments in proportion of 30-26-28-30-30-30-30-30-33-33-37-37-50; AR 0,81; sensory pattern 3, 8–10. Palpal segments (Plate 6d) with lengths in proportion of 13-33-40-15-17; PR 2,1; third segment short, moderately swollen, with a large, round, moderately deep, sensory pit on distal third. Proboscis short, P/H ratio 0,68; mandible with 15 teeth.

Thorax: Dark brown; mesonotum without prominent pattern, densely pale gray pollinose, with relatively large, sparse, suberect, whitish setae. Legs (Plate 6g) dark brown; fore and hind knee spots blackish; prominent yellowish banding at narrow bases of femora; narrow subapex of fore femur and narrow apex of mid femur, narrow bases of tibiae, and distal half of hind tibia; tibial comb (Plate 6f) with four spines, second from spur longest.

Wing (Plate 6e): Pattern as figured; pale areas interconnected, of distinctly whitish cast, leaving dark markings as three narrow, broken, zig-zag lines as figured; second radial cell dark to tip. Macrotrichia moderately numerous on distal third of wing but extremely fine-textured; radial cells distinct, second short and broad; CR 0,59. Halter pale.

Abdomen: Dark brown. Spermathecae (Plate 6c) one plus long, transversely striated, sclerotized ring; ovoid with long slender neck, measuring 0,072 by 0,043 mm.

Male.- - Similar to female, with usual sexual differences; antennal plume golden brown, three distal segments with lengths in proportion of 68-55-57; sensory pattern 3, 8–12. Genitalia (Plate 6i): Ninth sternum with broad, moderately deep, caudomedian excavation, ventral membrane not spiculate; ninth tergum long and tapering, with moderately long, pointed, apicolateral processes, caudal margin between them transverse. Basistyle long and slender; ventral root "foot-shaped", caudal heel well developed, anterior toe short, not much longer than heel; dorsal root long and slender; dististyle only slightly curved, long and slender, with bent, pointed tip. Aedeagus with basal arch extending to three-fourths of total length, basal arms curved, moderately slender but strongly sclerotized; distomedian process lightly sclerotized, short and narrow with rounded tip. Parameres (Plate 6h) each with dark basal knob; stem extremely long and slender, nearly straight, a suggestion of a ventral process at end of straight portion, beyond which paramere is abruptly narrowed and twisted lateroventrad, ending in filamentous point with distal fringing spines.

Distribution.- - Brazil.

Types.- - Holotype, female, Belém, Pará, Brazil, September 1969, T.H.G. AITKEN, light trap in APEG Forest. Allotype, male, same data but February 1970. Paratypes 26 males, 70 females, same data, but dates September 1967 to November 1970.

Discussion.- - This species is named in honour of Dr. JOSE C.M. CARVALHO, of the Museu Nacional, Rio de Janeiro, in recognition of his important contributions to Brazilian systematic entomology and our knowledge of the natural history of the Amazon.

Culicoides carvalhoi keys out in WIRTH and BLANTON (1959) to *galindoi* WIRTH and BLANTON, which differs in having two well developed spermathecae, antennal sensorial pattern 3, 7–10, a prominent mesonotal color pattern, and the pale wing spots more restricted, in addition to the lack of a ventral lobe on the male paramere. There are no known neotropical *Culicoides* with a single spermatheca that have this type of wing pattern.

This species was not recognized until the October 1969 light trap collections. In the 1970 collections from terra firme it occurred only sparingly and in slightly greater numbers in the tree canopy.

14.) *Culicoides cylindricornis* WIRTH and BLANTON, new species.
Plate 7.

Female.- - Wing length 1,32 mm.

Head: Eyes (Plate 7b) broadly separated, bare. Antenna (Plate 7a) with segments subcylindrical, the proximal ones especially elongate and provided with short, stiff, bristly verticils; lengths of flagellar segments in proportion of 60-47-45-45-43-42-40-40-40-40-44-44-74; AR 0,67; sensory pattern 3, 8–10. Palpal segments (Plate 7c) with lengths in proportion of 15-35-57-30-17; PR 3,2; third segment slightly swollen distally with a large round shallow sensory pit. Proboscis moderately long, P/H ratio 0,81; mandible with 20 minute teeth.

Thorax: Tawny yellowish brown, mesonotum darker brown on humeri and lateral margins. Legs (Plate 7e) with femora only moderately stout; pale brown, bases of tibiae slightly paler; tibial comb (Plate 7f) with four spines, the one nearest the spur longest.

Wing (Plate 7d): Yellowish hyaline, veins yellowish, with faint pattern as figured, consisting essentially of four broken, irregular, pale grayish transverse bands, one proximad of r–m crossvein, second at level of mediocubital fork, third at level of tip of vein M3+4, and fourth at level of tip of vein M2. Macrotrichia absent; costa elongate, CR 0,83; only one radial cell present, narrower at base, broader in distal portion. Halter slightly infuscated.

Abdomen: Pale brown, pleura dark grayish because of development of lines of dark microscopic spicules. Spermathecae (Plate 7g) two plus rudimentary third and sclerotized ring; short ovoid, with slightly oblique short necks; slightly unequal, measuring 0,055 by 0,045 mm and 0,052 by 0,040 mm.

Male.- - Unknown.

Distribution.- - Brazil.

Types.- - Holotype, female, Belém, Pará, Brazil, 18 November 1970, T.H.G. AITKEN, biting man on 35 m tree platform, 2200 hours, APEG Forest. Paratypes, same data as type, 1 female; same data except on 20 m platform at 2000 hours, 1 female; in light trap in APEG Forest, April 1970, 1 female.

Discussion.- - *Culicoides uniradialis* WIRTH and BLANTON from Panama and Colombia is similar to *cylindricornis* in general features including the very characteristic radial cell, but differs in its smaller size (wing 0,94 mm long), more distinct wing pattern, the dark markings more extensive, more tapering antennal segments, narrowly separated eyes, and stouter femora.

15.) *Culicoides dasyophrus* MACFIE
Culicoides dasyophrus MACFIE, 1940: 27 (male, female; Guyana). WIRTH and BLANTON, 1956c: 186 (redescribed; figures). FORATTINI, 1957: 503 (redescribed, figures).

Distribution.- - Brazil, Colombia, Guyana, Venezuela.
Type Locality.- - New River, Guyana.
Amazon records.- -
BRAZIL: Rio Branquinho, Amazonas, at cachoeira, 21 July 1961, FITTKAU (A209), at light, 1 female. Rio Cuieiras, Amazonas, above Igarapé Tukaneri, 19 December 1961, FITTKAU (A304), at light, 200 ex. Rio Marauiá, Amazonas, Cachoeira Bicho Acu, 31 December 1962, FITTKAU (A449), at light, 50 ex.; Cachoeira Tucuma, 1 January 1963, FITTKAU (A450), at light, 20 ex.; Cacheoira S. Antônio, 7 January 1963, FITTKAU (A469), at light, 1 000's; Mission S. Antônio, January 1963, FITTKAU (A484), at light, 1 000's; one day's travel above mission, large sandy beach, 22 January 1963, FITTKAU (A486), at light, 1 000's; Rio Irapirapi, 11 January 1963, FITTKAU (A479), at light, 1 000's. Rio Negro, Igarapé Agua Fria, 14 December 1960, FITTKAU (A58), reared, 8 females; Rio Negro, 2 km below Tapuruquara, 6 February 1963, FITTKAU (A511), reared from brook, 2 males, 2 females. Rio Parú de Oeste, Pará, Mission Tiriyós, 22–28 March 1962, FITTKAU (A361), at light, 1 000 ex.: Maloca Apico, 20 April 1962, FITTKAU (A366), at light, 200 ex.
COLOMBIA: Meta, Refugio Macarena, 10 January 1966, C.J. MARINKELLE, light trap, 15 females.

Remarks.- - On the headwaters of the Rio Parú de Oeste, FITTKAU took *C. dasyophrus* by the thousands in collections at light, with only occasionally a few other *Culicoides* species present such as *C. lutzi* and another undetermined species of the *diabolicus* group. Conditions were different along the headwaters of the Rio Marauiá and its tributaries, where although *dasyophrus* was still abundant, large numbers of *lutzi* and *paucienfuscatus* were also taken. At the Refugio Macarena, Meta, Colombia, MARINKELLE found the same association of *dasyophrus, paucienfuscatus,* and *lutzi* in his light trap collection. On the Rio Marauiá and Rio Irapirapi FITTKAU took hundreds of a small pale *Alluaudomyia* and a *Stilobezzia,* similar in size and colour to *C. dasyophrus.* These predaceous midges were probavly preying on the swarms of the *Culicoides* as well as Chironomidae.

16.) *Culicoides debilipalpis* LUTZ.
Culicoides debilipalpis LUTZ, 1913: 60 (female; Brazil; figure wing). FORATTINI, 1957: 383 (redescribed; figures). WIRTH and BLANTON, 1971: 34 (diagnostic characters; distribution).

Distribution.- - USA (Maryland to Florida), Panama to Argentina, Trinidad.
Type Locality.- - Serra da Bocaina, Formoso, São Paulo, Brazil.
Amazon records.- -
BRAZIL: Alto Amazonas (BARBOSA, 1947); Belém and Belterra, Pará (WARMKE, 1952); Rio Maruaru, Curralinho, Pará (COSTA LIMA, 1937).
Belém, Pará, APEG Forest, II, IV, V, VII, X 1969-70, AITKEN, light trap, 3 males, 4 females. AITKEN took 4 females biting man on 35 m platform in tree canopy in APEG Forest, 5 November 1970, 0600 hours.

Biology.- - WILLIAMS (1964) reared *debilipalpis* from rotting pods of cacao and from water in bamboo stumps in Trinidad. In the southeastern United States this species has been reared frequently from wet debris in tree cavities.

17.) *Culicoides eublepharus* MACFIE
Culicoides eublepharus MACFIE, 1948: 86 (female; Guyana). ORTIZ, 1952: 129 (redescribed; figures). FORATTINI, 1957: 493 (redescribed; figures).
Culicoides transferrans ORTIZ, 1953: 801 (Venezuela; figures). ORTIZ and LEON, 1955: 573 (Napo Pastaza, Ecuador). WIRTH and BLANTON, 1959: 424 (redescribed; figures).

Distribution.- - Brazil, Colombia, Costa Rica, Guyana, Panama, Venezuela.
Type Locality.- - New River, Guyana.
Amazon records.- -
BRAZIL: Rio Cuieiras, Amazonas, above Igarapé Tukaneri, December 19 1961, FITTKAU (A304), at light, 4 females. Rio Marauiá, Amazonas, above Mission S. Antonio near source in hills, 24–28 January 1963, FITTKAU (A492, A496, A502), at light, 2 males, 10 females. Rio Parú de Oeste, Pará, Mission Tiriyós, 22 March, 4 April 1962, FITTKAU (A361), at light, 12 females. Rio Solimões, Amazonas, Igarapé Amataura, 27 August 1961, FITTKAU (A240), at light, 3 females. Rio Tonantins, Amazonas, Villa Nova, 29 August 1961, FITTKAU (A245), at light, 3 females.
COLOMBIA: Tres Esquinas, Caquetá, 2 June 1968, C.J. MARINKELLE, light trap, 4 females.
ECUADOR: Archidona, Napo Pastaza (ORTIZ and LEON, 1955).

18.) *Culicoides fieldi* WIRTH and BLANTON.
Culicoides fieldi WIRTH and BLANTON, 1956b: 50 (male, female; Honduras; figures). WIRTH and BLANTON, 1959: 427 (redescribed; figures).

Distribution.- - Brazil, Costa Rica, Honduras, Panama.
Type Locality.- - Lancetilla, Honduras.
Amazon records.- -
BRAZIL: Belém, Pará, APEG Forest, IV 1969, AITKEN, light trap in várzea, 15 m in tree canopy, 2 females.

19.) *Culicoides filariferus* HOFFMAN.
Culicoides filariferus HOFFMAN, 1939: 172 (female; Mexico; figures).

Culicoides ocumarensis ORTIZ, 1950b: 455 (male, female; Venezuela; figures). ORTIZ and LEON, 1955: 571 (notes, figures; Ecuador).
Culicoides diabolicus HOFFMAN of authors.
Culicoides guttatus (COQUILLETT) of authors.

Distribution.- - Mexico, Central America from Guatemala to Panama, Ecuador, Colombia, Venezuela, Brazil, Trinidad.
Type Locality.- - El Vergel, Chiapas, Mexico.
Amazon records.- -
BRAZIL: Belém, Pará, 1955, DAMASCENO coll., 1 female. Belém, APEG Forest, VI, VII 1969, AITKEN, light trap, 2 females. Belém, IPEAN buffalo pasture, IX, X 1970, AITKEN, light trap, 2 males, 100 females. (Note abundance of *filariferus* in the campo, and scarcity in the forest). Belém, Utinga Forest, 29 April 1969, AITKEN, light trap, 1 female. Rio Negro, Amazonas, Igarapé da Bica, 23 June 1961, FITTKAU (A189), at light, 3 females. Rio Parú de Oeste, Pará, Mission Tiriyós, 22–28 March 1962, FITTKAU (A361), at light, 7 females; Malloca Apico, 20 April 1962, FITTKAU (A366), at light, 3 females. Rio Branquinho, Amazonas, 22 July 1961, FITTKAU (A212), at light, 1 female. Rio Prêto, Tiririca, Amazonas, 7 July 1962, FITTKAU (A396), at light, 5 females. Rio Prêto da Eva, Amazonas, 8 December 1962, FITTKAU (A441), at light, 1 male. Rio Solimões, Amazonas, Igarapé Amataura, 27 August 1961, FITTKAU (A240), at light, 2 females.

Remarks.- - The species of the *diabolicus* group have proved very difficult of analysis and in the past various authors have tended to give up and lump them all under the name *diabolicus* HOFFMAN or *guttatus* (COQUILLET). With more study and larger collections, however, we are beginning to recognize more and more valid species in this complex. *C. filariferus* can be recognized by the presence of two distal pale spots in cell M2, r–m crossvein without dark spot, third palpal segment slender with irregular pit, mesonotum with a large yellowish area in midportion, halteres dark, male apicolateral processes small and close together, and aedeagus with moderately broad base.

20.) *Culicoides fittkaui* WIRTH and BLANTON, new species.
Plate 8.

Female.- - Wing length 1,15 mm.
Head: Eyes (Plate 8c) contiguous, bare. Antenna (Plate 8a) with lengths of flagellar segments in proportion of 30-23-23-23-23-23-23-23-26-30-30-30-43; AR 0,84; sensory pattern 3, 8–10. Palpal segments (Plate 8b) with lengths in proportion of 12-33-48-20-22; PR 2,40; third segment slightly swollen, with small, deep sensory pit. Proboscis moderately short, P/H ratio 0,63; mandible with 18 teeth.
Thorax: Dark brown; mesonotum with pattern of darker, punctiform dots. Legs (Plate 8g) dark brown, knee spots blackish; fore and mid femora with subapical, all tibiae with sub-basal pale rings; hind tibia with pale apex; tibial comb (Plate 8f) with four spines, the one nearest the spur the longest.
Wing (Plate 8e): Pattern with extensive, more or less interconnected pale areas; second radial cell large with broad pale lumen; pale spot over r–m crossvein large, continuous with pale area behind medial fork and the single pale spot in distal portion of anal cell; base of wing extensively pale from costa into anal cell; poststigmatic pale area extends to vein M1 and continues proximad along hind margin of second radial cell, often fusing with pale spot over r–m crossvein; cell R5 with large, more or less oval pale spot in distal portion, broadly attaining anterodistal wing margin; cell M1 with two elongate pale spots, the second attaining wing margin; cell M2 with pale area continuous from base to level of proximal pale spot in cell M1, with a rounded pale spot at wing margin; cell M4 with large pale spot nearly filling cell, veins M1 and M2 extensively pale margined except at bases. Macrotrichia moderately sparse and confined to distal third of wing; CR 0,61. Halter infuscated.
Abdomen: Dark brown. Spermathecae (Plate 8d) two plus rudimentary third and large ring; oval with moderately long slender necks; slightly unequal, measuring 0,057 by 0,038 mm and 0,049 by 0,033 mm.

Male.- - Similar to female, with usual sexual differences; antenna with long brown plume; last three segments with lengths in proportion of 45-38-56; sensory pattern 3, 10–12. Genitalia (Plate 8i): Ninth sternum with deep caudomedian excavation, ventral membrane bare; ninth tergum moderately long and

tapering, with long, slender, subparallel, apicolateral processes. Basistyle slender, ventral root without posterior "heel", dorsal root slender; dististyle slender, nearly straight proximad, abruptly bent distally with pointed tip. Aedeagus with basal arch extending to about half of total length, basal arms relatively stout; distal process long and slender, slightly tapering. Parameres (Plate 8h) strongly sclerotized, short and stout; each with stout basal knob and stout, curving basal portion, a large stout ventral lobe present, distal portion tapering to pointed tip and bearing minute lateral fringing spines.

Distribution.- - Brazil.

Types.- - Holotype, female, Belém, Pará, Brazil, August 1970, T.H.G. AITKEN, light trap in APEG Forest, terra firme. Allotype, male, same data, but July 1970. Paratypes, 7 males, 2 females, same data but January to July 1970.

We are naming this species in honour of Dr. ERNST J. FITTKAU of the Max-Planck-Institut für Limnologie, Plön, Germany, in recognition of his outstanding contributions to our knowledge of the freshwater fauna of the Amazon region. We are greatly indebted to Dr. FITTKAU for permitting us to study the Ceratopogonidae he collected during his three years of work in the Amazon Valley.

Culicoides fittkaui is nearly identical with *C. guamai* n. sp., but the second radial cell has a broader lumen which is conspicuously pale in color, the palpal pit is deeper, the parameres are stouter, and their ventral lobe is stronger, and the aedeagus has a longer distomedian process.

This species is closely related to *C. daviesi* WIRTH and BLANTON (1965b) from the Rupununi Savannah, Guyana, but *daviesi* has the pale wing markings more extensive, the second radial cell longer, the palpus much shorter with a shallower round pit, the antenna more elongate and slender, with sensory pattern 3, 7–10, and onla one functional spermatheca present.

21.) *Culicoides flavivenula* COSTA LIMA.
Culicoides flavivenula COSTA LIMA, 1937: 418 (female; Brazil; figure palpus). WIRTH and BLANTON, 1956a: 318 (redescribed; figures). FORATTINI, 1957: 235 (redescribed; figures).

Distribution.- - Brazil, Trinidad.
Type Locality.- - Angra dos Reis, Japuíba, Rio de Janeiro, Brazil.
Amazon records.- -
BRAZIL: Belém, Pará, August 1955, R.G. DAMASCENO, 5 females (FORATTINI, 1957). Belém, APEG Forest, in light traps, AITKEN collector, 55 specimens taken throughout the year, 1969–70, slightly more numerous in várzea collections.

22.) *Culicoides fluvialis* MACFIE.
Culicoides fluvialis MACFIE, 1940: 25 (female; Guyana; figure wing). FORATTINI, 1957: 330 (redescribed; figures). WIRTH and BLANTON, 1959: 407 (redescribed; figures).

Distribution.- - Brazil, Guyana, Honduras, Panama, Trinidad, Venezuela.
Type Locality.- - New River, Guyana.
Amazon records.- -
BRAZIL: Belém, Pará, APEG Forest, I, III, VI 1970, AITKEN, light trap in terra firme, 4 males. Rio Branquinho at mouth Rio Cuieiras, Amazonas, 23 July 1961, FITTKAU (A218), at light, 3 females. Rio Marauiá, Amazonas, Chamata mountain district, 19 January 1963, FITTKAU, (A483), at light, 1 female. Santarém, Pará, Hotel Oriental, 3–11 January 1961, FITTKAU (A87), at light, 3 males. Rio Tocantins, Amazonas, 5 November 1960, FITTKAU (A50), at light, 1 female.

Biology.- - WILLIAMS (1964) reared this species from rotting cacao pods in Trinidad. WIRTH and BLANTON (1968) reared it from rotting inflorescences of the Panama hat palm, *Carludovica palmata*, in Panama.

23.) *Culicoides fluviatilis* (LUTZ).
Johannseniella fluviatilis LUTZ, 1914: 4 (female; Brazil; figure wing). LANE, 1945: 363 (redescribed; figure antenna).
Culicoides fluviatilis (LUTZ); ORTIZ, 1958: 39 (notes; synonym: *scorzai*).
Culicoides scorzai ORTIZ, 1956: 93 (female; Venezuela).
Culicoides pachymerus LUTZ; FORATTINI, 1957: 305 (misidentified; redescribed; figures).

Distribution.- - Brazil, Ecuador, Trinidad, Venezuela.
Type Locality.- - São Gabriel, Rio Negro, Brazil.
Amazon records.- -

BRAZIL: Rio Negro, Amazonas, February 1913, C. CHAGAS, 2 females cotypes (FORATTINI, 1957); Lagoa do Taruma, Cachoeira Alta, Manaus, Amazonas, November 1955, ELIAS and ROPPA, 6 females (FORATTINI, 1957); Lagoa do Passarhino, Manaus, Amazonas, November 1955, ELIAS and ROPPA, 10 females (FORATTINI, 1957). Rio Cuieiras, Amazonas, Igarapé Cachoeira, 15 April 1961, FITTKAU (A151), at light, 1 female. Rio Marauiá, Amazonas, Mission S. Antônio, 21 January 1963, FITTKAU (A484), at light, 1 female.

Habits.- - This species is a severe biting pest of man in Trinidad.

24.) *Culicoides foxi* ORTIZ

Culicoides foxi ORTIZ, 1950c: 461 (male, female; Puerto Rico, Venezuela). FORATTINI 1957: 205 (redescribed; figures). WIRTH and BLANTON, 1959: 283 (redescribed; figures).

Distribution.- - Central America, West Indies (Puerto Rico, Jamaica, Dominica), Colombia, Venezuela, Trinidad, Brazil, Argentina (Corrientes).
Type Locality.- - Caracas, Venezuela.
Amazon records.- -

BRAZIL: Belém, Pará, APEG Forest, 1969–70, AITKEN, light traps. This was an abundant species in the wet season, taken in large numbers both in várzea and terra firme collections, more abundant in trappings at ground level in the wet season (January to May) but not decreasing so rapidly in the tree canopy collections as the dry season progressed. AITKEN took 11 females biting man in APEG Forest,at ground level and on 20 and 35 m platforms, 1900–2000 hours, in November and December 1970. Rio Aripuana, Amazonas, Benificante, 15 January 1962, FITTKAU (A318) at light, 1 female. Rio Cururú, Pará, Mission Cururú, January 1961, FITTKAU (A88), at light, 25 females. Rio Parú de Oeste, Pará, Mission Tiriyós (A361), 22 March 1962; Igarapé Okueima, brook with quiet current (A371); and Igarapé Kumadueni (A377), 19 April 1962, FITTKAU, at light, 6 females. Rio Marauiá, Amazonas, above Mission S. Antônio, vicinity border mountains, stream with sand bottom, deep and shallow water, 24 January 1963, FITTKAU (A492), at light, 60 females. Rio Solimões, Amazonas, 15 km below Coari, 13 September 1961, FITTKAU (A261), at light, 30 females; Ilha Juçara, 3 September 1961, FITTKAU (A255), at light, 1 female; Igarapé Amataura, 27 August 1961, FITTKAU (A240), at light, 1 female.

COLOMBIA: Los Alicangaros, Caqueta, 20 April 1970, C.J. MARINKELLE, light trap, 1 female; Refugio Macarena, Meta, 10 January 1966, MARINKELLE, light trap, 1 female; Puerto Leguizamo, Putamayo, 25 June 1968, MARINKELLE, light trap, 50 females.

Biology.- - WILLIAMS (1964) reared *foxi* from a variety of habitats in Trinidad; grassy shaded and sunny ditch and stream margins, rain soaked cow and horse manure, and rotting cacao pods.

25.) *Culicoides freitasi* WIRTH and BLANTON, new species.
Plate 9.

Female.- - Wing length 0,98 mm.

Head: Eyes (Plate 9b) narrowly separated, bare. Antenna (Plate 9a) with lengths of flagellar segments in proportions of 30-20-20-20-20-20-20-22-45-45-50-50-63; AR 1,45; sensory pattern 3, 11–15. Palpal segments (Plate 9c) with lengths in proportion of 10-26-35-12-13; PR 1,95; third segment moderately swollen, with a round deep sensory pit. Proboscis short, P/H ratio 0,59; mandible with 13 teeth.

Thorax: Yellowish brown; mesonotum with pattern of dark brown mottling and punctiform brown dots. Legs (Plate 9e) brownish, knee spots blackish; fore and mid femora with subapical and all tibiae with basal, pale bands; hind tibial comb (Plate 9f) with four spines, the two nearest the spur longest, subequal.

Wing (Plate 9d): Pattern as figured, dark brown with coarse microtrichia and distinct, small pale spots; pale spot over r–m crossvein moderately large, not reaching costal margin; cell R5 with two separate oblique, poststigmatic pale spots, a pale streaklike spot lying adjacent to midportion of vein M1, and a large transverse pale spot in distal portion; pale spot present straddling midportion of vein M2, cell M1 with pale spot in distal portion separated from wing margin by dark area equal to its own length; cell M2 with pale spot at base, pale spots lying behind medial fork and ahead of mediocubital fork, and a round

pale spot lying near but seoarate from wing margin; cell M4 with pale line following veins at base of fork, expanding at midportion of vein M3+4 to a pale spot lying ahead of round pale spot at wing margin in distal part of cell; anal cell with four small pale spots, two in basal portion and two in distal portion; pale spots at wing margin at apices of veins M1, M2, and M3+4. Macrotrichia long and abundant, extending to base of cell M2 and anal cell; radial cells with distinct lumens; CR 0,63. Halter pale.

Abdomen: Dark brown. Spermathecae (Plate 9g) two, with rudimentary third and sclerotized ring; oval with short, slender necks; unequal, measuring 0,043 by 0,033 mm and 0,038 by 0,030 mm.

Male: Unknown.

Distribution.- - Brazil

Types.- - Holotype, female, Belém, Pará, Brazil, June 1969, T.H.G. AITKEN, APEG Forest light trap in terra firme, 32 m in tree canopy. Paratype, 2 females, same data, except August 1968 and September 1969.

Discussion.- - This species is named for Senhor EMANUEL NAZARENO DE FREITAS of the Belém Virus Laboratory not only for designing the light traps and the means of ascent into the tree canopy, but also in appreciation of his assistance in carrying on the field work which resulted in this superb taxonomic collection of *Culicoides*.

Culicoides freitasi is similar in wing pattern to *C. iriartei* FOX, but differs in having two pale spots in the distal portion of the anal cell and only one pale spot lying adjacent to the proximal portion of vein M1. The antennal sensory pattern places it in the *daedalus* Group of WIRTH and BLANTON (1959) where the wing pattern is similar to that of *crescentis* WIRTH and BLANTON, but that species has the mesonotal pattern of large pale patches and the palpal pit opens by a smaller pore as in other members of the group.

26.) *Culicoides fusipalpis* WIRTH and BLANTON, new species.
Plate 10.

Female.- - Wing length 1,04 mm.

Head: Eyes (Plate 10c) contiguous, bare. Antenna (Plate 10a) with lengths of flagellar segments in proportion of 30-25-25-25-25-25-27-30-40-44-44-46-54; AR 1,21; sensory pattern 3, 11–15. Palpal segments (Plate 10b) with lengths in proportion of 12-42-45-20-20; PR 3,5; third segment fusiform, slightly swollen in midportion only, with scattered surface sensilla. Proboscis moderately long, P/H ratio 0,85; mandible with 12 teeth.

Thorax: Dark brown; mesonotum without prominent pattern. Legs (Plate 10 g) dark brown; mid femur narrowly yellowish at apex; all tibiae with basal, and hind tibia with apical, broad yellowish bands; tibial comb (Plate 10f) with five spines, the second from the spur longest.

Wing (Plate 10e): Pattern as figured, wing dark brown with distinct, contrasting pale spots; three darker brown areas on anterior margin before r–m crossvein, over tip of vein R1, and past poststigmatic pale spot, and a small dark brown spot lying on base of vein M1; pale spot over r–m crossvein broadly reaching costal margin; pale spot lying over distal 0,6 of second radial cell extending a short distance past tip of costa, not penetrated by dark area along vein R4+5; distal pale spot in cell R5 broadly meeting anterior wing margin; a double pale spot straddling midportion of vein M2; cell M1 with only one small round pale spot, lying distant from wing margin; cell M2 pale at base, pale spots lying behind medial fork and in front of mediocubital fork, and a large pale spot broadly meeting wing margin in apex of cell; cell M4 with a small round pale spot meeting wing margin in distal portion, separate from the large pale area bordering veins along base of mediocubital fork, but apices of veins M3+4 and Cul dark; apices of veins M1 and M2 with pale spots at wing margin; anal cell pale at base and with two pale spots in distal portion. Macrotrichia sparse on distal fourth of wing; radial cells distinct, first slitlike, second with with broad lumen; CR 0,67. Halter pale
Halter pale.

Abdomen: Dark brown. Spermathecae (Plate 10d) two with rudimentary third and sclerotized ring; subspherical with short, slender neck; subequal, each measuring 0,051 by 0,036 mm.

Male.- - Similar to female, with usual sexual differences; antennal plume golden brown; last three segments with lengths in proportion of 67-65-80, sensory pattern 3, 13–15. Genitalia (Plate 10i): Ninth sternum with narrow, shallow, caudomedian excavation, ventral membrane not spiculate; ninth tergum broadly rounded distally, caudomesal margin not lobed, but with widely separated, small, slender, apico-

lateral processes. Basistyle moderately stout, with dense, fine, mesal setae; dististyle moderately stout, curving, with moderately stout, pointed tip. Aedeagus with basal arch low, extending 0,2 of total length, with strong transverse sclerotization; sides slightly convex, distally tapering to slender tip with subspherical termination, distinct internal sclerotized peg present. Parameres (Plate 10h) fused a short distance at bases; each with short basal processes directed anteriorly, midportion stout, with a lateral wrinkle, abruptly tapering distad to short, slender, filiform tip with distinct fringing hairs.

Distribution.- - Brazil, Colombia, Ecuador, Guyana.

Types.- - Holotype, female, allotype, male, Belém, Pará, Brazil, August 1969, T.H.G. AITKEN, light trap in APEG Forest. Paratypes 16 males, 198 females, as follows:

BRAZIL: Same data as types, but dates January to December, 1968–70, 15 males, 150 females; Belém, APEG Forest, AITKEN, biting man, 4 November 1970, ground level, 2000 hours, 1 female; Utinga Forest, Belém, 29 April 1969, T.H.G. AITKEN, light trap, 2 females; Rio Marauiá, Amazonas, Mission S. Antonio, January, February, 1963, FITTKAU (A469, A484, A492), at light, 11 females; Seringeiro Tapirí, 2 January 1963, FITTKAU (A452), 1 female. Rio Branquinho, Lager Tapirí, 22 July 1961, FITTKAU (A213), at light, 3 females; at mouth Rio Cuieiras, 23 July 1962, FITTKAU (A218), at light, 1 male, 8 females.

COLOMBIA: Los Alicangaros, Caquetá, April 1970, C.J. MARINKELLE, light trap, 1 female; Puerto Leguizama, Putumayo, 25 June 1968, C.J. MARINKELLE, light trap, 2 females; Rio Raposo, Valle, March 1963 to March 1964, V.H. LEE, light trap, 16 females.

ECUADOR: Cayapas, Esmeraldas Prov., 12 December 1956, L.A. LEON, 3 females; Santo Domingo de los Colorados, Pichincha Prov., January 1956, L.A. LEON, 1 female.

GUYANA: Oko River, 20 June 1936, N.A. WEBER, 1 female.

Discussion.- - The presence of only one distal pale spot in cell M1 and the absence of a dark line following vein R4+5 into the poststigmatic pale spot in cell R5 allies *C. fusipalpis* with *lutzi* COSTA LIMA, from which it can be readily distinguished by the fusiform third palpal segment with scattered surface sensilla. The wing markings are more contrasting than in *C. batesi* n. sp., in which species the halter is dark and the palpal pit is definite, but irregular.

In the APEG Forest this species was taken in small to moderate numbers both in várzea and terra firme, but many more at ground level than in the tree canopy.

27.) *Culicoides gabaldoni* ORTIZ

Culicoides gabaldoni ORTIZ, 1954: 221 (female; Venezuela; figures). WIRTH and BLANTON, 1959: 431 (redescribed; figures).

Distribution.- - Brazil, British Honduras, Colombia, Guatemala, Mexico, Nicaragua, Panama, Trinidad Venezuela.
Type Locality.- - San Felipe, Yaracuy, Venezuela.
Amazon records.- -
BRAZIL: Belém, Pará, APEG Forest, 18 November 1970, AITKEN, biting man, 1700 hours on 20 m tree platform, 1 female.

Biology.- - WILLIAMS (1964) reared *gabaldoni* from decaying cacao pods in Trinidad.

28.) *Culicoides ginesi* ORTIZ

Culicoides ginesi ORTIZ, 1951a: 586 (female; Venezuela; figures). FORATTINI, 1957: 395 (redescribed; figures). WIRTH and BLANTON, 1959: 450 (redescribed; figures).

Distribution.- - Brazil, Panama, Trinidad, Venezuela.
Type Locality.- - San Felipe, Yaracuy, Venezuela.
Amazon records.- -
BRAZIL: Belém, Pará, APEG Forest, VII, IX, XI 1970, AITKEN, light trap in terra firme, 2 males, 2 females.

29.) *Culicoides glabellus* WIRTH and BLANTON

Culicoides glabellus WIRTH and BLANTON, 1956b: 47 (male, female; Panama; figures). WIRTH and BLANTON, 1959: 429 (redescribes; figures).

Distribution.- - Brazil, Colombia, Honduras, Nicaragua, Panama, Trinidad.
Type Locality.- - Almirante, Bocas del Toro, Panama.
Amazon records.- -
BRAZIL: Belém, Pará, APEG Forest, IV, V, 1969, AITKEN, light trap in várzea, 15 m in tree canopy, 4 females. APEG Forest, 2 December 1970, AITKEN, biting man 1700 hours on 20 m platform in tree canopy, 1 female.
COLOMBIA: Puerto Leguizamo, Putumayo, 25 June 1968, C.J. MARINKELLE, light trap, 10 females.

Biology.- - WILLIAMS (1964) reared *glabellus* from a rotting banana stump and from rotting cacao pods in Trinidad.

30.) *Culicoides glabrior* MACFIE

Culicoides debilipalpis var. *glabrior* MACFIE, 1940: 27 (male, female; Guyana).
Culicoides glabrior MACFIE; WIRTH and BLANTON, 1959: 452 (redescribed; figures; synonym: *grahambelli* FORATTINI).
Culicoides grahambelli FORATTINI, 1956: 35 (female; Panama).

Distribution.- - Brazil, Guyana, Honduras, Panama, Trinidad.
Type Locality.- - New River, British Guiana.
Amazon records.- -
BRAZIL: Belém, Pará, APEG Forest; AITKEN took this species in light traps in small to moderate numbers throughout the year, with a peak at the end of the wet season. It was far more abundant in terra firme and in the tree canopy.

Biology.- - WILLIAMS (1964) reared this species from rotting flowers of *Clusia rosea* (Guttiferae) in Trinidad.

31.) *Culicoides goeldii* WIRTH and BLANTON, new species.
Plate 11.

Female.- - Wing length 1,24 mm.

Head: Eyes (Plate 11d) nearly contiguous, bare. Antenna (Plate 11a) with lengths of flagellar segments in proportion of 37-32-32-33-33-33-33-33-36-33-30-30-40; AR 0,64; sensory pattern 3, 7–10. Palpal segments (Plate 11b) with lengths in proportion of 15-40-58-25-23; PR 2,90; third segment moderately slender with round deep sensory pit. Proboscis moderately long, P/H ratio 0,75; mandible with 18 teeth.

Thorax: Dark brown; mesonotum (Plate 11e) with prominent pattern of punctiform dots and dark patches on anterior portion. Legs (Plate 11h) dark brown, knee spots blackish; fore and mid femora with subapical and all tibiae with sub-basal, narrow pale rings; tibial comb with five spines, the one nearest the spur longest.

Wing (Plate 11c): Pattern of extensive, interconnected, whitish spots and pale areas, leaving restricted contrasting dark areas as follows: two small proximal marks, one from costa to base of media proximad of r–m crossvein, the second lying behind distal third of mediocubital stem; a series of four dark marks in second band, one comprising second radial cell, a small round dark spot behind this in cell R5, a dark mass over base of medial fork, and a dark mark at base of mediocubital fork following vein Cu1 to wing margin; a third broken dark band across distal fourth of wing to end of vein M3+4, distad of which the cells are nearly filled with three pale spots, the anterior one nearly filling distal portion of cell R5 but with dark area at tip of cell, the distal pale spot in cell M1 elongate and meeting wing margin, and pale spot in tip of cell M2 broadly meeting wing margin. Macrotrichia moderately abundant on distal half of wing and in tip of anal cell; radial cells with distinct lumens; CR 0,58. Halter saturate dark brown.

Abdomen: Dark brown. Spermathecae (Plate 11g) two plus rudimentary third and a peculiar disc-like ring with small perforation at the duct; oval with short slender necks, slightly unequal, measuring 0,049 by 0,029 mm and 0,043 by 0,029 mm.

Male.- - Similar to female, with usual sexual differences; antenna with long brown plume; last three

segments with lengths in proportion of 55-36-45; sensory pattern 3, 10–12. Genitalia (Plate 11j): Ninth sternum with shallow caudomedian excavation, ventral membrane not spiculate; ninth tergum moderately long and tapering, with long, slender, subparallel apicolateral processes. Basistyle slender, with peculiarly lobed ventral root and slender dorsal root; dististyle nearly straight, slender, with bent pointed tip. Aedeagus with basal arch extending to 0,45 of total length, basal arms moderately stout; distomedian process moderately stout and tapering to rounded tip bearing numerous strong spicules. Parameres (Plate 11i) each with stout basal knob, stem moderately stout and slightly curved, distally tapering without ventral lobe or abrupt constriction, narrowing to slender filamentous tip without fringing spines.

Distribution.- - Brazil.

Types.- - Holotypes, female, Belém, Pará, Brazil, March 1970, T.H.G. AITKEN, light trap in APEG Forest, terra firme. Allotype, male, same data but January 1970. Paratypes, 32 males, 13 females, same data, but dates January to November 1970.

This species is named in honor of Dr. EMÍLIO GOELDI, renowned medical entomologist and director of the Museu Paraense "Emilio Goeldi" in Belém when the epoch-making discoveries on mosquitoes and tropical diseases were in full sway.

Culicoides goeldi is similar to *C. fittkaui* n. sp. and *C. guamai* n. sp. in general wing pattern and mesonotal pattern of punctiform brown dots, but it is readily distinguished by its very dark halteres, and whitish shade of the wing with much reduced dark markings which include a conspicuous small round dark spot behind the second radial cell in cell R5. The distally spiculate aedeagus is diagnostic for the male genitalia.

32.) *Culicoides guamai* WIRTH and BLANTON, new species.
Plate 12.

Female.- - Wing length 1,12 mm.

Head: Eyes (Plate 12d) nearly contiguous, bare. Antenna (Plate 12a) with lengths of flagellar segments in proportion of 30-25-25-25-25-25-25-25-33-32-37-38-56; AR 0,96; sensory pattern 3, 8–10. Palpal segments (Plate 12b) with lengths in proportion of 16-32-43-18-20; PR 2,15; third segment slightly swollen with small, round, moderately deep sensory pit. Proboscis moderately long, P/H ratio 0,76; mandible with 16 teeth.

Thorax: Brownish; mesonotum (Plate 12e) with prominent pattern of punctiform brown dots. Legs (Plate 12h) brownish, knee spots blackish; fore and mid femora with subapical and all tibiae with sub-basal pale rings, hind tibia with apex pale; tibial comb (Plate 12f) with four spines, the one nearest the spur longest.

Wing (Plate 12c): Pattern with extensive, more or less interconnected pale areas; pale area over r–m crossvein large, continuous with pale area behind medial fork and single pale spot in distal portion of anal cell; wing pale at base, including anterobasal portion of anal cell; poststigmatic pale area extends to vein M1 and continues proximad along hind margin of second radial cell, often fusing with pale spot over r–m crossvein; cell R5 with large, more or less oval pale spot in distal portion, broadly attaining antero-distal wing margin; cell M1 with large pale area in basal portion and an elongate pale spot meeting wing margin; cell M2 with large pale area lying in front of the large rounded pale spot nearly filling cell M4, and a rounded pale spot at wing margin; veins M1 and M2 extensively pale margined, vein M3+4 with pale spot at wing margin. Macrotrichia rather sparse and confined to distal third of wing; radial cells with distinct lumen; second radial cell short with dark lumen; CR 0,62. Halter pale.

Abdomen: Pale brown. Spermathecae (Plate 12g) two plus rudimentary third and large ring; moderately sclerotized, oval with slightly irregular outlines, with short slender necks; slightly unequal, measuring 0,065 by 0,038 mm and 0,059 by 0,035 mm.

Male.- - Similar to female, with usual sexual differences; antenna with sparse brown plume; last three segments with lengths in proportion of 55-45-62; sensory pattern 3, 10–12. Genitalia (Plate 12j): Ninth sternum with shallow caudomedian excavation, ventral membrane not spiculate; ninth tergum moderately long and tapering, with long, slender, subparallel apicolateral processes, the caudal margin between them not cleft. Basistyle slender, with foot-shaped ventral root and slender dorsal root; dististyle straight proximally, slender distally with bent, pointed, hooklike tip. Aedeagus with basal arch broad and rounded, extending to 0,6 of total length; distal process slender with parallel sides and slender, simple, blunt tip. Parameres (Plate 12i) highly sclerotized, each with large basal knob, a strong ventral swelling on proximal portion of stem, slender distally without ventral lobe, tapering to filamentous tip with lateral fringing spines.

Distribution.- - Brazil.

Types.- - Holotype, female, allotype, male, Belém, Pará, Brazil, October 1969, T.H.G. AITKEN, light trap in APEG Forest, terra firme, at 32 m in tree canopy. Paratypes, 30 males, 29 females, same data except dates also February to December 1969, 1970.

The name *guamai* refers to the Guamá River, where the APEG Forest is located. This species is closely related to *C. paucienfuscatus* BARBOSA, but can readily be distinguished by the poor development of the small dark spot behind the apex of the second radial cell, by the presence of only one pale spot in the distal portion of the anal cell, and by the mesonotal pattern of punctiform brown dots. *Culicoides fittkaui* n. sp. is also very similar, but it is distinguished by the longer second radial cell with pale lumen.

Culicoides guamai was taken in small to moderate numbers in light traps operated at the terra firme station, mostly in the tree canopy.

33.) *Culicoides guerrai* WIRTH and BLANTON
Culicoides guerrai WIRTH and BLANTON, 1971: 41 (male, female; Trinidad; figures).

Distribution.- - Brazil, Trinidad.
Type Locality.- - Tucker Valley, Trinidad.
Amazon records.- -
BRAZIL: Belém, Pará, APEG Forest, January to October 1969–70, AITKEN, light trap, 16 males, 2 females.

34.) *Culicoides heliconiae* FOX and HOFFMAN
Culicoides heliconiae FOX and HOFFMAN, 1944: 108 (female; Venezuela; figure wing). WIRTH and BLANTON, 1959: 274 (redescribed; figures). WIRTH and BLANTON, 1968: 205 (redescribed; figures).
Culicoides rozeboomi BARBOSA, 1947: 26 (male, female; Trinidad; figures).
Culicoides hylas MACFIE; FORATTINI, 1957: 244 (misidentified; redescribed; figures).

Distribution.- - Brazil, Colombia, Costa Rica, Grenada, Honduras, Panama, Trinidad, Venezuela.
Type Locality.- - Maracay, Venezuela (*heliconiae*); Trinidad (*rozeboomi*).
Amazon records.- -
BRAZIL: Belém, Pará, APEG Forest, 3 September 1970, AITKEN, light trap, 1 female. Rio Marauiá, Amazonas, Cachoeira near border mountains 24, 28 January 1963, FITTKAU (A496, A502), at light, 1 male, 1 female.
COLOMBIA: Los Alicangaros, Caqueta, 20 April 1970, C.J. MARINKELLE, light trap, 1 female.

Biology.- - WILLIAMS (1964) reared *heliconiae* from flowers of *Heliconia* and *Calathea* and from a decaying banana stump in Trinidad. WIRTH and BLANTON (1968) reported that it had been reared from bromeliads in Venezuela and *Heliconia* in Panama.

35.) *Culicoides hylas* MACFIE
Culicoides hylas MACFIE, 1940: 26 (female; Guyana; figure wing). FORATTINI, 1957: 243 (redescribed; figures). WIRTH and BLANTON, 1959: 276 (redescribed; figures).

Distribution.- - Mexico to Brazil and Peru.
Type Locality.- - New River, Guyana.
Amazon records.- -
BRAZIL: Belém, Pará, APEG Forest; AITKEN took this species in light traps throughout the year in large numbers, more numerous in terra firme collections than in várzea, and in much greater numbers in tree canopy than at ground level. The numbers decreased abruptly in the dry season after an August peak. Rio Parú de Oeste, Pará, Mission Tiriyos, 22 March 1962, FITTKAU (A361), at light, 1 male, 1 female.
COLOMBIA: Tres Esquinas, Caquetá, 2 June 1968, C.J. MARINKELLE, light trap, 1 male.

Biology.- - Breeds in *Calathea violacea* in Panama (WIRTH and BLANTON 1959). Reared from rotting spadices of Panama hat palm, *Carludovica palmata* (WIRTH and BLANTON, 1968).

36.) *Culicoides ignacioi* FORATTINI

Culicoides ignacioi FORATTINI, 1957: 215 (male, female; Brazil; figures).

Distribution.- - Brazil.
Type Locality.- - Salesópolis, Boracéa, São Paulo, Brazil.
Amazon records.- -

BRAZIL: Belém, Pará, August 1955, R.G. DAMASCENO, 1 female (FORATTINI, 1957). Belém, APEG Forest, 1969–70, AITKEN. Taken in light traps in small numbers, about equally in várzea and terra firme, and at ground level or tree canopy. Belém, APEG Forest, 1 female biting man 2000 hours on 20 m platform in canopy, 2 December 1970, AITKEN. Belém, Utinga Forest, 29 April 1969, AITKEN, light trap, 1 female. Rio Cururú, Pará, Mission Cururú, 6 February 1961, FITTKAU (A88), at light, 2 males, 4 females. Rio Madeira, Amazonas, Madeirinha, 12 September 1960, FITTKAU (A13), at light, 1 female. Rio Solimões, Amazonas, Ponta Periquitos, 15 September 1961, FITTKAU (A264), at light, 1 female; Ilha Juçara, 3 September 1961, FITTKAU (A255), at light, 2 females. São Antônio near Manaus, Amazonas, 13 December 1961, FITTKAU (A283), at light, 5 females.

37.) *Culicoides insignis* LUTZ

Culicoides insignis LUTZ, 1913: 50 (male, female, pupa; Brazil; figure wing). FORATTINI, 1957: 223 (redescribed; figures). WIRTH and BLANTON, 1959: 285 (redescribed; figures).

Distribution.- - USA (Florida), Mexico to Brazil, Argentina (Corrientes), West Indies.
Type Localities.- - Rio de Janeiro and Bahia, Brazil.
Amazon records.- -

BRAZIL: Belém, Pará, August 1955, R.G. DAMASCENO, 551 females (FORATTINI, 1957). Serra do Cachimbo, Pará, October 1956, TRAVASSOS, OLIVEIRA and ADÃO, 1 female (FORATTINI, 1957). Belém, APEG Forest, 1969–70, AITKEN, light traps; a rare species, taken occasionally throughout the year; commoner in várzea in the dry months and more taken in tree canopy than at ground level. Rio Amazonas, Amazonas, São Geraldo, 1 hour below mouth of Rio Madeira, 12 January 1962, FITTKAU (A311), at light, 6 females. Rio Cururú, Pará, Mission Cururú, 6 February 1961, FITTKAU (A88), at light, 1 male, 1 female. Rio Madeira, Pará, Parana Madeirinha, 11 September 1960, FITTKAU (A12), at light, 100 ex. Rio Negro, Amazonas, Igarapé da Bica, 23 June 1961, FITTKAU (A189), at light, 10 females. Rio Parú de Oeste, Pará, Mission Tiriyós, 31 March 1962, FITTKAU (A361), at light, 3 females. Rio Prêto, Amazonas, Tiririca, 7 July 1962, FITTKAU (A396), at light, 1 female. Rio Solimões at Rio Negro, Amazonas, 17 March 1961, FITTKAU (A144), at light, 2 females; Ilha do Careiro, Lago do Rei, 16 March 1961, FITTKAU (A139), at light, 1 female.

COLOMBIA: Pto. Leguizamo, Putumayo, 25 June 1968, C.J. MARINKELLE, light trap, 1 female; Refugio Macarena, Meta; 10 January 1966, MARINKELLE, light trap, 4 females.

Biology.- - WILLIAMS (1964) reared *insignis* in Trinidad repeatedly from margins of drainage ditches and small streams, some grassy and sunny, others shaded. He also reared it from runoff from a cow manure pile, a sunny spring outcrop in a pasture, fish pond margin, and a tidal river edge in salt marsh grass.

38.) *Culicoides insinuatus* ORTIZ and LEON

Culicoides insinuatus ORTIZ and LEON, 1955: 577 (female; Ecuador; figures). FORATTINI, 1957: 373 (redescribed; figures).

Distribution.- - Brazil, Ecuador, Trinidad.
Type Locality.- - Nuevo Rocafuerte, Napo-Pastaza, Ecuador.
Amazon records.- -

BRAZIL: Curralinho, Pará, Rio Maruaru, June 1936, H. KUMM, 2 females, (FORATTINI, 1957); Lagoa do Passarinho, Manaus, Amazonas, November 1955, ELIAS and ROPPA, 3 females (FORATTINI, 1957). Belém, Pará, APEG Forest, 18 November 1970, T.H.G. AITKEN, biting man 1700 hours in 35 m tree platform, 2 females.

ECUADOR: Nuevo Rocafuerte, Napo-Pastaza, (ORTIZ and LEON, 1955).

39.) *Culicoides iriartei* FOX

Culicoides iriartei FOX, 1952: 368 (female; Venezuela; figures). WIRTH and BLANTON, 1959: 344 (redescribed; figures; synonym: *vargasi*).
Culicoides baueri HOFFMAN; ORTIZ and MIRSA, 1951: 599 (misidentified; redescribed; figures). FORATTINI, 1957: 475 (misidentified; redescribed; figures).
Culicoides vargasi WIRTH and BLANTON, 1953: 74 (male, female; Panama; figures).

Distribution.- - Brazil, Colombia, Honduras, Panama, Venezuela.
Type Locality.- - La Salina, Venezuela (*iriartei*); Las Tablas, Panama (*vargasi*).
Amazon records.- -

BRAZIL: Belém, Pará, APEG Forest, July 1968, February to December 1970, AITKEN, light traps in terra firme, 5 males, 4 females.

40.) *Culicoides lanei* ORTIZ

Culicoides lanei ORTIZ, 1950a: 431 (male; Panama; figures).FORATTINI, 1957: 472 (redescribed; figures). WIRTH and BLANTON, 1959: 374 (redescribed; figures).

Distribution.- - Brazil, Honduras, Panama, Trinidad, Venezuela.
Type Locality.- - Cerro Sefa, Panama.
Amazon records.- -

BRAZIL: Belém, Pará, APEG Forest, 1969–70, AITKEN, light traps; a rare species taken mostly in terra firme, collections nearly equal between ground level and tree canopy. Belém, APEG Forest, 1 female biting man, 2300 hours, 4 November 1970, AITKEN, on 20 m platform in canopy.

41.) *Culicoides leopoldoi* ORTIZ

Culicoides leopoldoi ORTIZ, 1951a: 579 (female; Venezuela; figures).FORATTINI, 1957: 409 (redescribed; figures). WIRTH and BLANTON, 1959: 418 (redescribed, figures).

Distribution.- - Bolivia, Brazil, Colombia, Panama, Trinidad, Venezuela.
Type Locality.- - Ocumare del Tuy, Miranda, Venezuela.
Amazon records.- -

BRAZIL: Belém, Pará, 1969–70, AITKEN, light traps; abundant from February to September, with a one month lag following the wet season; várzea collections decreasing rapidly after onset of dry season in June, but terra firme collections remaining high until October. Rio Branquinho, mouth Rio Cuieiras, Amazonas, 18 July 1961, FITTKAU (A205), at light, 1 male; same, 23 July 1961, FITTKAU (A218), at light, 8 females. Rio Marauiá, Amazonas, 3 days travel above Mission S. Antônio, 24 January 1963, FITTKAU (A490), at light, 1 female. Rio Solimões, Amazonas, mouth Rio Takana, 15 August 1961, FITTKAU (A231), 1 female; Ponta Periquitos, 15 September 1961, FITTKAU (A264), at light, 1 female; Igarapé Uarini, 4 September 1961, FITTKAU (A256), at light, 1 male; Igarapé Amataura, 27 August 1961, FITTKAU (A240), at light, 1 female.

Biology.- - WILLIAMS (1964) reared *leopoldoi* in Trinidad from the margins of ditches and small streams of various sorts. BREELAND (1960) collected it in Panama in emergence cages in fresh water mangrove swamp and over saturated soil in a forest area.

41.) *Culicoides limai* BARRETTO

Culicoides limai BARRETTO, 1944: 99 (male; Brazil; figures). FORATTINI, 1957: 335 (redescribed; figures). WIRTH and BLANTON, 1959: 352 (redescribed; figures).

Distribution.- - Brazil, Colombia, Ecuador, Honduras, Panama, Trinidad, Venezuela.
Type Locality.- - Mogi das Cruzes, São Paulo, Brazil.
Amazon records.- -

BRAZIL: Serra do Cachimbo, Pará, October 1956, TRAVASSOS, OLIVEIRA and ADÃO, 2 males, 6 females (FORATTINI, 1957). Belém, Pará, APEG Forest, 1969–70, AITKEN; common in light traps; slightly more abundant in the várzea, and found equally at ground level and in the tree canopy; its numbers did not diminish with the dry season. Rio Parú de Oeste, Pará, Mission Tiriyós, 22 March, 3 April 1962, FITTKAU (A361), at light, 1 male, 2 females; Igarapé Moeneni, 29 March

1962, FITTKAU (A363), 1 female; Igarapé Okueima, 17 April 1962, brook with strong flow, FITTKAU (A371), at light, 1 female; Malloca Apico, 20 April 1962, FITTKAU (A366), at light, 1 female.

Biology.- - WILLIAMS (1964) reared this species in Trinidad from the sunny, grassy margin of a tidal drainage ditch and from the sandy margin of a fluctuating forest stream.

43.) *Culicoides limonensis* ORTIZ and LEON

Culicoides limonensis ORTIZ and LEON, 1955: 576 (female; Ecuador; figures). FORATTINI, 1957: 378 (redescribed; figures).

Distribution.- - Brazil, Ecuador, Venezuela.
Type Locality.- - Limones, Esmeraldas, Ecuador.
Amazon records.- -

BRAZIL: Serra do Cachimbo, Pará, October 1956, TRAVASSOS, OLIVEIRA, and ADÃO, 3 females (FORATTINI, 1957).

44.) *Culicoides lutzi* COSTA LIMA

Culicoides lutzi COSTA LIMA, 1937: 419 (female; Brazil; figure palpus). WIRTH and BLANTON, 1956a: 318 (redescribed; figures). FORATTINI, 1957: 237 (redescribed; figures).

Distribution.- - Brazil, Colombia, Guyana.
Type Locality.- - Abaete, Pará, Brazil.
Amazon records.- -

BRAZIL: Abaete, Pará, June 1936, E. CHAGAS, 1 female cotype (FORATTINI, 1957). Belém, Pará, August 1955, R.G. DAMASCENO, 49 females (FORATTINI, 1957). Serra do Cachimbo, Pará, October 1956, TRAVASSOS, OLIVEIRA and ADÃO, 1 male (FORATTINI, 1957). Rio Madeira, Amazonas, 20 km from Rio Amazon, 10 September 1960, FITTKAU (A11), at light, 1 male, 20 females; Madeirinha, 12 September 1960, FITTKAU (A13), at light, 200 females. Rio Marauiá, Amazonas, Mission S. Antonio, 21 January 1963, FITTKAU (A484), at light, 50 females; Cachoeira Bicho-Acu, 31 December 1962, FITTKAU (A449), at light, 10 females; Cachoeira S. Antonio, 10 January 1963, FITTKAU (A475), at light, 10 females; one day's travel above mission, large sandy beach, 22 January 1963, FITTKAU (A486), at light, 500 ex.; three day's travel above mission, end of long cachoeira, stream coming out of hills, 24 January 1963, FITTKAU (A496), at light, 1 000 ex. Rio Negro, Amazonas, Igarapé da Bica, 23 June 1961, FITTKAU (A189), at light, 2 females; Moura near Rio Branco, 5 February 1962, FITTKAU (A331), at light, 5 females. Rio Solimões, Amazonas, Florianapolis, 31 August 1961, FITTKAU (A249), at light, 1 female; Rio Irapirapi, Ponte Inhira, 11 January 1963, FITTKAU (A481), at light, 300.; Ilha do Careiro, Lago do Rei, 19 March 1961, FITTKAU (A319), at light, 4 females; Igarapé Amataura, 27 August 1961, FITTKAU (A240), at light, 5 females; S. Antonio do Ica, 27 August 1961, FITTKAU (A242), at light, 25 females; Favonio, 1 September 1961, FITTKAU (A253), at light, 4 females; Ilha Jucara, 3 September 1961, FITTKAU (A255), at light, 1 male, 30 females; Igarapé Uarini, 4 September 1961, FITTKAU (A256), at light, 3 females; Igarapé Catua, 10 September 1961, FITTKAU (A257), at light, 1 female; mouth Rio Ipixuna, 12 September 1961, FITTKAU (A260), at light, 2 females; 10 km below Coari, 13 September 1961, FITTKAU (A261), at light, 1 male, 5 females; Ponta Periquitos, 15 September 1961, FITTKAU (A264), at light, 1 male, 1 female. Rio Parú de Oeste, Pará, Mission Tiriyós, 23 March 1962, FITTKAU (A361), at light, 1 male, 3 females. Rio Tonantins, Amazonas, Villa Nova, 29 August 1961, FITTKAU (A245), at light, 5 females. São Antonionear Manaus, Amazonas, 13 December 1961, FITTKAU (A283), at light, 1 female.
COLOMBIA: Refugio Macarena, Meta, 10 January 1966, C.J. MARINKELLE, at light, 1 female.

Remarks.- - The abundance of *C. lutzi* in FITTKAU's Rio Marauiá and Rio Solimões collections, especially at the large sandy beach site, and its absence in the APEG Forest collections at Belém, suggest that this species is adapted to the nutrient poor streams in the central Amazon, probably breeding in the sandy margins.

45.) *Culicoides palpalis* MACFIE

Culicoides palpalis MACFIE, 1948: 78 (female; Mexico). WIRTH and BLANTON, 1968a: 207 (redescribed; figures).

Distribution.- - Nicaragua to Peru and Venezuela.
Type Locality.- - San Cristobal, north of Aurora, Chiapas, Mexico.
Amazon records.- -

COLOMBIA: Caquetá, Los Alicangaros, 20 April 1970, C.J. MARINKELLE, light trap, 4 females.

46.) *Culicoides paraensis* (GOELDI)

Haematomyidium paraense GOELDI, 1905: 137 (female; Brazil; figures).
Culicoides paraensis (GOELDI);LUTZ, 1913: 5(redescribed; figure wing). ORTIZ and LEON, 1955: 570 (Napo-Pastaza, Ecuador). FORATTINI, 1957: 426 (redescribed; figures). WIRTH and BLANTON, 1959: 440 (redescribed; figures).

Distribution.- - USA (Pennsylvania to Mississippi and Florida), Central and South America to Argentina, West Indies.
Type Locality.- - Belém, Pará, Brazil.
Amazon records.- -

BRAZIL: Belém, Pará (GOELDI, 1905); Rio Tocantins (LUTZ, 1913); Travesa São Pedro, Belém, Pará, 13 April 1969, AITKEN, engorging on man in living room 1715 hours, 1 female; Belém, APEG Forest, V, IX, XI 1970, AITKEN, light trap in terra firme, 3 males; Belém, APEG Forest, biting man 1700 hours on 20 m platform in canopy, 18 November, 2 December 1970, AITKEN, 2 females.
PERU: Loreto, San Antonio, 500 ft elevation, 22 August 1955, J.C. HITCHCOCK, biting man in tent, 1 female.
COLOMBIA: Tres Esquinas, Caquetá, 2 June 1968, C.J. MARINKELLE, light trap, 1 female.

Biology.- - WILLIAMS (1964) reared *paraensis* in Trinidad numerous times from decaying cacao pods and once from a rotting calabash. BREELAND (1960) reared it from tree hole debris in Panama.

47.) *Culicoides paramaruim* WIRTH and BLANTON, new species.
Plate 13.

Female.- - Wing length 1,13 mm.

Head: Eyes contiguous, bare. Antenna (Plate 13a) with lengths of flagellar segments in proportion of 30-25-25-30-30-30-30-30-40-40-43-50-73; AR 1,23; sensory pattern 3, 11–15. Palpal segments (Plate 13c) with lengths in proportion of 10-25-50-20-17; PR 2,8; third segment short, moderately swollen, with scattered sensilla on surface. Proboscis moderately long, P/H ratio 0,80; mandible with 18 teeth.

Thorax: Dark brown; mesonotum without prominent pattern. Legs (Plate 13f) dark brown, bases of tibiae only slightly paler, apex of hind tibia with pale band; tibial comb (Plate 13c) with five spines, the second from the spur longest.

Wing (Plate 13d): Pattern as figured: wing dark grayish brown with coarse microtrichia and inconspicuous, somewhat variable pattern of diffuse pale spots; second radial cell pale on distal half, but vein R4+5 infuscated along posterior side to its tip; r–m crossvein slightly darkened anteriorly where it meets radius; pale spot in cell R5 behind 2RC small, distal pale spot in cell R5 transverse, not reaching wing margin; distal pale spots in cells M1, M2 and M3+4 small and not reaching wing margin; pale spot straddling vein M2 small and sometimes divided by vein; base of cell M4 slightly pale, pale line along vein M3+4 does not meet wing margin; pale spots present behind medial fork and in front of mediocubital fork; anal cell with two distal pale spots, the posterior one faint. Macrotrichia present on distal third of wing; 1RC slit-like, 2RC with broad lumen; CR 0,66. Halter dark brown.

Abdomen: Dark brown. Spermathecae (Plate 13b) two plus rudimentary third and sclerotized ring; subspherical with short slender necks; subequal, each measuring 0,046 by 0,040 mm.

Male.- - Similar to female with usual sexual differences; antennal plume brown; three distal segments with lengths in proportion of 65-55-80; sensory pattern 3, 13–15. Genitalia (Plate 13h): Ninth sternum with caudal margin not distinct in available specimens; ninth tergum bluntly rounded distally with small,

widely spaced, apicolateral processes, the caudal margin between them not cleft or lobed. Basistyle with mesal spinosity not coarse; dististyle distinctly curved with bluntly rounded tip. Aedeagus with basal arch low, moderately broad, sides evenly tapered to slender, papilliform tip, proximal sclerotized margin and internal peg present. Parameres (Plate 13g) joined at base with a slender connective; each with a moderately stout body, tapering abruptly at midportion to slender filiform distal process bearing minute fringing distal hairs.

Distribution.- - Brazil.

Types.- - Holotype, female, Belém, Pará, Brazil, APEG Forest, May 1969, T.H.G. AITKEN, light trap. Allotype, male, same data but date March 1970. Paratypes, 1 male, 9 females, same data but dates February to December 1969, 1970; 14 females, Belém, IPEAN water buffalo pasture, light trap at pumping station at Rio Guamá, October 1970, T.H.G. AITKEN.

Discussion.- - *Culicoides maruim* LUTZ, which is a pest species of coastal mangrove swamps from Southern Brazil to Guyana and Trinidad, is closely related and similar to *paramaruim*, but differs in having the third palpal segment much longer and more slender, the male ninth tergum with a mesal cleft, the aedeagus with a broader basal arch and stouter tip, and the parameres with shorter distal filaments.

48.) *Culicoides paucienfuscatus* BARBOSA

Culicoides paucienfuscatus BARBOSA, 1947: 23 (female; Brazil, Panama; figures). FORATTINI, 1957: 345 (redescribed; figures). WIRTH and BLANTON, 1959: 381 (redescribed; figures).

Distribution.- - Brazil, Colombia, Panama, Trinidad.
Type Locality.- - Manaus, Amazonas, Brazil.
Amazon records.- -

BRAZIL: Manaus, Amazonas (BARBOSA, 1947); Serra do Cachimbo, Pará, October 1956, TRAVASSOS, OLIVEIRA and ADÃO, 1 male, 1 female (FORATTINI, 1957). Belém, Pará, APEG Forest, 1969-70, AITKEN; not abundant in light trap collections, where it was almost exclusively a terra firme species, in slightly greater numbers in the tree canopy than at ground level. Belém, 12 December 1969, AITKEN, from nares of dead juvenile bird (yellow rumped Cacique, *Cacicus cela*, Icteridae), 6 females, engorged. Belém, APEG Forest, 22 females in 8 collections, biting man on 20 and 35 m platforms in tree canopy, 2000 to 0400 hours, November, December 1970, AITKEN. Rio Cuieras, Amazonas, 22–29 November 1962, FITTKAU (A411, A413, A418, A422, A435), at light: Igarapé Cachoeira - 62 females, igapó at junction with Rio Branquinho - 25 females; Igarapé Cachoeira, 15 April 1961, FITTKAU (A151), at light, 1 female; Rio Branquinho, 23 April 1961, FITTKAU (A169), at light, 1 male. Rio Madeira, Amazonas, 10 September 1960, FITTKAU (A11), at light, 2 females; Parana Madeirinha, 11 September 1960, FITTKAU (A12), at light, 1 female. Rio Marauiá, Amazonas, Mission S. Antonio, Cachoeira S. Antonio, 10, 21 January 1963, FITTKAU (A475, A484, A490), at light, 30 females; 1–3 days travel above mission (A486, A492), 400 ex. Rio Taruma, Amazonas, 17 December 1962, below Sucuuba, FITTKAU (A407), at light, 10 females. Rio Parú de Oeste, Pará, Mission Tiriyós, 29 March 1962, FITTKAU (A361), at light, 2 females. Rio Solimões, Amazonas, Igarapé Amataura, 27 August 1971, FITTKAU (A240), at light, 4 males, 5 females.

COLOMBIA: Refugio Macarena, Meta, 10 January 1966, C.J. MARINKELLE, light trap, 1 female. Tres Esquinas, Caquetá, 2 June 1968, MARINKELLE, light trap, 1 female.

Biology.- - WILLIAMS (1964) reared this species in Trinidad from a grassy sunny tidal ditch, a shaded grassy forest stream, and from rain-soaked cow manure.

Remarks.- - On the Rio Cuieiras, FITTKAU found *C. paucienfuscatus* to be the dominant *Culicoides* in his light trap catches. In the igapós at the mouths of tributary streams such as the Igarapé Cachoeira and the Rio Branquinho, a large yellow ceratopogonid of the predaceous genus *Paryphoconus* was also taken in large numbers with *paucienfuscatus.*

49.) *Culicoides pifanoi* ORTIZ

Culicoides pifanoi ORTIZ, 1951a: 588 (male, female; Venezuela; figures). FORATTINI, 1957: 342 (redescribed; figures). WIRTH and BLANTON, 1959: 384 (redescribed; figures).

Distribution.- - Brazil, Colombia, Ecuador, Honduras to Panama; Trinidad, Venezuela.
Type Locality.- - San Felipe, Yaracuy, Venezuela.
Amazon records.- -

BRAZIL: Belém, Pará, APEG Forest, April 1969, AITKEN, light trap, terra firme, 32 m in tree canopy, 1 female. Belém, APEG Forest, 6 females in 5 collections biting man on 20 and 35 m platforms in canopy, November 1970, AITKEN.

Biology.- - This species breeds in bracts of *Heliconia mariae* (WIRTH and BLANTON, 1959). WILLIAMS (1964) reared it in Trinidad from a shaded vegetated stream margin, and from overflow from a ground pool into a similar stream.

50.) *Culicoides pilosus* WIRTH and BLANTON
Plate 14.

Culicoides pilosus WIRTH and BLANTON, 1959: 332 (male, female; Panama; figures).

Distribution.- - Brazil, Colombia, Costa Rica, Panama.
Type Locality.- - Almirante, Bocas del Toro, Panama.
Amazon records.- -

BRAZIL: Belém, Pará, APEG Forest, III, IV 1970, AITKEN, light trap in terra firme, 1 male, 1 female.

Remarks.- - The characters of the female are illustrated in Plate 14.

51.) *Culicoides propriipennis* MACFIE

Culicoides propriipennis MACFIE, 1948: 84 (female, Mexico, figure wing). FORATTINI, 1957: 442 (redescribed,; figures). WIRTH and BLANTON, 1959: 412 (redescribed; figures).

Distribution.- - Mexico to Panama, Venezuela, Ecuador, Brazil.
Type Locality.- - San Cristobal, Chiapas, Mexico.
Amazon records.- -

BRAZIL: Belém, Pará, APEG Forest, February to September 1969–70, AITKEN, light traps, 4 males, 10 females.

52.) *Culicoides pseudodiabolicus* FOX

Culicoides pseudodiabolicus FOX, 1946: 256 (female; Trinidad; figure wing).
Culicoides guttatus (COQUILLETT) of authors.
Culicoides diabolicus HOFFMAN of authors.

Distribution.- - Brazil, Colombia, Costa Rica, Ecuador, French Guiana, Honduras, Panama, Trinidad, Venezuela.
Type Locality.- - Cumuto Village, Trinidad.
Amazon records.- -

BRAZIL: Belém, Pará, APEG Forest, 1969–70, AITKEN, light traps; this species was abundant in light trap collections throughout the year, but in far less numbers during the dry season. It was found in greater numbers in terra firme than in the várzea and about equally at ground level or in the tree canopy. AITKEN took 49 females in 24 collections biting man in the APEG Forest, at ground level, 20 and 35 m platforms, in November and December 1970, from 1900 to 0700 hours. Rio Amazonas, Amazonas, São Geraldo, 1 hr below mouth Rio Madeira, 21 January 1963, FITTKAU (A483), at light, 3 females. Rio Branquinho, Amazonas, 22 July 1961, FITTKAU (A212), reared from bamboo zone, 1 female; mouth Rio Cuieiras, 18 July 1961, FITTKAU (A205), at light, 1 male; same, 23 July 1961, FITTKAU (A218), at light, 5 females. Rio Cururú, Pará, Mission Cururú, 19 January 1961, FITTKAU (A88), at light, 2 males. Rio Marauiá, Amazonas, headwaters, mountain brook falling strongly over granite boulders, 26 January 1963, FITTKAU (A498), at light, 1 female; Chamata mountain area, 19 January 1963, FITTKAU (A483), Rio Negro, Amazonas, Igarapé, da Bica mouth, 23 June 1961, FITTKAU (A240), at light, 1 male, 3 females; Ilha Marara, 8 February 1962, FITTKAU (A337), at light, 1 male, 2 females. Santarém, Pará, Hotel Oriental, 3–11 June 1961, FITTKAU (A87), at light, 3 females. Rio Solimões, Amazonas, mouth Rio Takana, 15 August 1961, FITTKAU (A231), at light, 1 male, 2 females; near S. Antonio do Ica, 28 August 1961, FITTKAU

(A242), at light, 3 females; Igarapé Catua, 10 September 1961, FITTKAU (A257), at light, 1 female; Ponte Periquitos, 15 September 1961, FITTKAU (A264), at light, 1 female; Igarapé Amataura, 27 August 1961, FITTKAU (A240). Rio Tocantins, Amazonas, Rio Impex, 5 November 1960, FITTKAU (A50), at light, 6 females. Rio Tonantins, Amazonas, Villa Nova, 29 August 1961, FITTKAU (A245), at light, 1 female.

COLOMBIA: Los Alicangaros, Caqueta, 20 April 1970, C.J. MARINKELLE, light trap, 200 females. Puerto Leguizamo, Putumayo, August 1969, MARINKELLE, light trap, 4 females.

Biology.- - WILLIAMS (1964) reared *pseudodiabolicus* (reported as *diabolicus*) in Trinidad from the edge of a fish pond.

Remarks.- - Because of the difficulty in separating the species of the *guttatus* group, *C. pseudodiabolicus* has for some time been placed in synonymy with *guttatus* (COQUILLETT) (see FORATTINI, 1957) or *diabolicus* HOFFMAN (see WIRTH and BLANTON, 1959). Detailed study of extensive recent collections from Central and South America and the West Indies has enabled us to recognize a number of valid species in this complex, including *pseudodiabolicus* FOX. This species is characterized by its small to moderate wing size (wing about 1,0 mm long), presence of two distal pale spots in cell M1, pale wing spots not highly contrasting nor extensively interconnected, r–m crossvein infuscated on anterior end, vein M3+4 usually with apex dark, third palpal segment short with subdivided pit, spermathecae larger and slightly unequal, necks slender, and apicolateral processes of male genitalia widely separated, the margin between them not deeply bilobed. *Culicoides guttatus* is a southern Brazilian species, larger in size with a slender third palpal segment, pale wing spots extensive, interconnected, vein M3+4 pale its entire length, and halter pale, *C. diabolicus* is a Central American species, with r–m crossvein pale, the third palpal segment relatively stout with irregular pit, spermathecae subequal, and male apicolateral processes closer together, the aedeagus with terminal papilla.

53.) *Culicoides pusillus* LUTZ

Culicoides pusillus LUTZ, 1913: 52 (female; Brazil; figure wing). FORATTINI, 1957: 284 (redescribed; figures). WIRTH and BLANTON, 1959: 292 (redescribed; figures).

Distribution.- - Mexico and West Indies, Central and South America to Brazil and Ecuador.
Type Locality.- - Manguinhos, Brazil.
Amazon records.- -

BRAZIL: Rio Marauia, Amazonas, vicinity of border mountains, 24 January 1963, FITTKAU (A492), at light, 1 female. Rio Tonantins, Amazonas, Villa Nova, 29 August 1961, FITTKAU (245), at light, 1 female.

Biology.- - WILLIAMS (1964) reared *pusillus* in Trinidad from decaying cacao pods, calabash, banana stalks and stumps, animal bedding, wet horse and cow manure, bamboo stumps, decaying *Heliconia* flowers, and a grassy drainage ditch margin.

54.) *Culicoides rangeli* ORTIZ and MIRSA

Culicoides rangeli ORTIZ and MIRSA, 1952: 126 (female; Venezuela; figures). FORATTINI, 1957: 502 (redescribed; figures). WIRTH and BLANTON, 1959: 423 (redescribed; figures).

Distribution.- - Colombia, Costa Rica, Ecuador, Panama, Trinidad, Venezuela.
Type Locality.- - Los Chorros, Miranda, Venezuela.
Amazon records.- -

ECUADOR: Archidona, Province Napo-Pastaza (ORTIZ and LEON, 1955).

BRAZIL: Rio Marauia, Amazonas, above Mission S. Antonio near source in hills, 28 January 1963, FITTKAU (A502), at light, 1 female.

55.) *Culicoides reticulatus* LUTZ

Culicoides reticulatus LUTZ, 1913: 49 (male, female; Brazil; biology; figures). FORATTINI, 1957: 432 (redescribed; figures). WIRTH and BLANTON, 1959: 393 (redescribed; figures).

Distribution.- - Brazil, Colombia, Costa Rica, Panama.
Type Locality.- - Santos, and Rio de Janeiro, Brazil, larvae in crab holes.

Amazon records.- -

BRAZIL: Belém, Pará, APEG Forest, 1969)70, AITKEN; 44 specimens taken in light traps, more from terra firme than from the várzea, and more often at ground level than in the tree canopy.

Biology.- - Breeds in crab holes (LUTZ, 1913; FORATTINI et al., 1958).

56.) *Culicoides tetrathyris* WIRTH and BLANTON

Culicoides tetrathyris WIRTH and BLANTON, 1959: 409 (male, female; Panama; figures).

Distribution.- - Brazil, Ecuador, Honduras, Panama, Trinidad.
Type Locality.- - Almirante, Bocas del Toro, Panama.
Amazon records.- -

BRAZIL: Belém, Pará, APEG Forest, March 1969, AITKEN, light trap in várzea, 15 m in tree canopy, 1 female.

Biology.- - WILLIAMS (1964) reared this species in Trinidad from decaying cacao pods.

57.) *Culicoides todatangae* WIRTH and BLANTON, new species.
Plate 15.

Female.- - Wing length 0,88 mm.

Head: Eyes (Plate 15b) narrowly separated, with long interfacetal hairs. Antenna (Plate 15a) with lengths of flagellar segments in proportion of 30-24-25-25-25-25-27-28-32-30-35-38-53; AR 0,90; sensory pattern 3, 8–10. Palpal segments (Plate 15d) with lengths in proportion of 12-38-45-20-20; PR 3,2; third segment long and slender, with a small sensory pit deeper than diameter of pore opening. Proboscis long, P/H ratio 0,95; mandible with 22 teeth.

Thorax: Dark brown; mesonotum without prominent pattern. Legs (Plate 15g) dark brown, femora dark to tips, tibiae with narrow basal pale rings, hind tibia pale at apex; tibial comb (Plate 15f) with four spines, the one nearest the spur longest; legs with rather strong setiform hairs, especially on femora, hind femur rather stout.

Wing (Plate 15e): Pattern as figured; dark brown with contrasting whitish distinct spots; pale spot over r–m crossvein extends from costal margin to media; poststigmatic pale spots narrowly contiguous, round, the posterior one located distinctly proximad of the other; distal pale spot in cell R5 transverse to slightly reniform; cell M1 with two small oval pale spots, the distal one located at least twice its length from wing margin; cell M2 with a large pale spot at base covering basal arculus and part of base of medial stem, a distinct oval pale spot lying against midportion of mediocubital stem, a pale spot behind medial fork, and a pale spot at tip of cell near wing margin, no pale spot lying ahead of mediocubital fork; anal cell with one rounded pale spot in distal portion. Macrotrichia sparse and confined to distal third of wing; first radial cell slitlike, second incomplete because of obsolescence of vein R2+3; CR 0,58. Halter slightly infuscated.

Abdomen: Dark brown. Spermathecae (Plate 15c) two plus rudimentary third and ring; oval with long slender necks; slightly unequal, measuring 0,058 by 0,036 mm and 0,055 by 0,033 mm.

Male.- - Similar to female, with usual sexual differences; antennal plume long and dense, brownish; three distal segments with lengths in proportion of 52-42-63; sensory pattern 3, 10–12. Genitalia (Plate 15i): Ninth sternum with shallow caudomedian excavation, ventral membrane not spiculate; ninth tergum moderately long and tapering, apicolateral processes short and bluntly angulate, the caudal margin between them distinctly cleft. Basistyle rather stout, ventral root "foot-shaped", dorsal root slender; dististyle only slightly curved, slender distally with bent, pointed tip. Aedeagus with basal arch extending to 0,55 of total length, basal arms moderately stout and nearly straight; distal process tapering to short, simple rounded tip. Parameres (Plate 15h) each with dark basal knob, stem slender, sinuate, especially on proximal portion, ventral lobe absent, tapering distally to sharp point with lateral fringing spines.

Distribution.- - Brazil.

Types.- - Holotype, female, Belém, Pará. January 1970, T.H.G. AITKEN. light trap in APEG Forest, terra firme, ground level. Allotype, male, same data but date February 1970. Paratypes, 6 males, 4 females, same data but dates July 1969, January to September 1970; 1 female, Belém, APEG Forest,

AITKEN, biting man, 2 December 1970, 20 m platform in canopy, 1700 hours; 1 male, Nova Teutonia, Santa Catarina, Brazil, October 1965, F. PLAUMANN.

Discussion.- - This species is dedicated to Dona AMAZÔNIA TODA TANG, of the Belém virus laboratory, in appreciation of her assistance in the operation of the entomolgy department.

Culicoides todatangae is a typical member of the *debilipalpis* group where it most closely resembles *C. insinuatus* ORTIZ and LEON; both species having the pale spot in cell M2 in front of the mid-portion of the mediocubital stem. The latter species differs from *todatangae* in having the eyes broadly separated, the third palpal segment broader with shallow sensory pit, the wing much shorter and broader with the pale spots grayish rather than whitish, the halter dark brownish, a distinct pale spot present in front of mediocubital fork, and distinct ventral lobe present on the male parameres.

58.) *Culicoides travassosi* FORATTINI

Culicoides travassosi FORATTINI, 1957: 198 (male, female; Pará, Brazil; figures).

Distribution.- - Brazil (Pará, Mato Grosso).

Type Locality.- - Serra do Cachimbo, Pará, Brazil.

Amazon records.- -

BRAZIL: Serra do Cachimbo, Pará, January 1956, L. TRAVASSOS and S. OLIVEIRA, (holotype, female, allotype, male, 15 paratypes).

Discussion.- - Resembles *C. foxi* ORTIZ in the presence of black spots over r–m crossvein and at tip of 2RC, but differs in possession of a third pale spot at tip of cell R5. Male aedeagus has tip papilliform rather than truncated as in *foxi.*

59.) *Culicoides vernoni* WIRTH and BLANTON, new species.

Plate 16.

Female.- - Wing length 1,00 mm.

Head: Eyes (Plate 16b) nearly contiguous, bare. Antenna (Plate 16a) with lengths of flagellar segments in proportion of 25-21-22-23-23-24-25-25-41-41-42-42-65; AR 1,22; sensory pattern 3, 8–10. Palpal segments (Plate 11d) with lengths in proportion of 10-25-30-14-12; PR 2,0; third segment short and moderately swollen with a shallow round sensory pit. Proboscis moderately short, P/H ratio 0,66; mandible with 13 teeth.

Thorax: Brown, mesonotum with prominent pattern of large yellowish patches. Legs (Plate 16g) dark brown; knee spots blackish; fore and mid femora with subapical and all tibiae with sub-basal, narrow pale rings; tibial comb (Plate 16f) with four spines, the one nearest the spur longest.

Wing (Plate 16c): Pattern as figured; with large, moderately distinct pale spots centering in the cells; second radial cell dark to tip; pale spot over r–m crossvein large, extending broadly to costal margin; cell R5 with a single large poststigmatic pale spot, extending along posterior margin of second radial cell; distal pale spot in cell R5 large, filling apex of cell with dark area bordering tip of vein M1 very little expanded apically; cell M1 with two elongate pale spots, the second broadly reaching wing margin; cell M2 with pale area at wing base, a large pale area from behind medial fork to in front of mediocubital fork, two pale spots in distal portion of cell, the second broadly reaching wing margin; cell M4 with a large pale spot broadly reaching wing margin; anal cell with a double pale spot in distal portion. Macrotrichia sparse and confined to wing tip; radial cells complete, first slitlike, second with distinct lumen; CR 0,62. Halter pale to only slightly infuscated.

Abdomen: Pale brown. Spermathecae (Plate 16c) two plus rudimentary third and sclerotized ring; oval with long slender necks, subequal in size but one more oval, measuring 0,49 by 0,030 mm and 0,046 by 0,033 mm.

Male.- - Similar to female with usual sexual differences; antenna with long brownish plume; last three segments with lengths in proportion of 55-52-75; sensory pattern 3, 10–12. Genitalia (Plate 16i): Ninth sternum with deep caudomedian excavation, the ventral membrane spiculate; ninth tergum long and tapering, with moderately long, triangular, pointed apicolateral processes, the caudal margin between them not bilobed. Basistyle slender, ventral root foot-shaped, dorsal root slender; dististyle slender, curved,

with bent, sharp-pointed tip. Aedeagus with basal arch extending to 0,6 of total length, basal arms moderately slender and only slightly curved; distal portion short and slender, with simple truncated tip. Parameres (Plate 16h) each with dark basal knob; stem slender, curved at base, straight in midportion, with a distinct ventral lobe distally, narrow distal portion curved ventrad and tapering to sharp point with lateral fringing spines.

Distribution.- - Brazil, Colombia.

Types.- - Holotype, female, Belém, Pará, Brazil, January 1970, T.H.G. AITKEN, light trap in APEG Forest, terra firme, ground level. Allotype, male, same data but February 1970, 32 m in tree canopy. Paratypes, 27 males, 69 females, as follows: BRAZIL: Belém, same data as types but light trap in várzea and terra firme, January to December 1968–70. 7 males, 11 females.

COLOMBIA: Rio Raposo, Valle, January to August 1963, 1964, V.H. LEE, light trap, 20 males, 58 females.

Discussion.- - This species is named for Dr. VERNON H. LEE of the Rockefeller Foundation in appreciation of his contributions to our knowledge of Colombian biting midges while he was entomologist at the arbovirus laboratory at Cali, Colombia.

Culicoides vernoni is closely related to and has a nearly identical wing pattern to *C. limai* BARRETTO and *C. galindoi* WIRTH and BLANTON, but in both related species the distal pale spot in cell R5 is rounded distally leaving a sizeable dark area at apex of cell. *C. limai* has male genitalia nearly identical with *vernoni,* but the hind femur has a distinct subapical pale ring. *C. galindoi* has the hind femur dark to tip, but the male parameres lack the ventral lobe.

60.) *Culicoides wallacei* WIRTH and BLANTON, new species.

Plate 17.

Female.- - Wing length 1,47 mm.

Head: Eyes (Plate 17e) nearly contiguous, bare. Antenna (Plate 17a) with lengths of flagellar segments in proportion of 60-50-50-50-45-45-45-45-50-50-55-52-85; AR 0,75; sensory pattern 3, 8–10. Palpal segments (Plate 17c) with lengths in proportion of 15-30-53-20-18; PR 2,30; third segment moderately slender with a moderately deep round sensory pit. Proboscis moderately short, P/H ratio 0,65; mandible with 15 teeth.

Thorax: Dark brown; mesonotum with prominent pattern of large yellowish patches. Legs (Plate 17g) brown; knee spots blackish; fore and mid femora with subapical and all tibiae with sub-basal,narrow pale rings; hind tibia broadly pale at apex; tibial comb (Plate 17f) with four spines, the two nearest the spur longest, subequal.

Wing (Plate 17b): Pattern as figured, three very dark areas on anterior margin; pale spots moderately distinct; large pale spot over r–m crossvein broadly meeting costal margin; poststigmatic pale spot in cell R5 in form of a broad U-shaped marking enclosing a small dark spot behind tip of second radial cell, this marking often nearly pinched off into three pale spots and also narrowly connected to the oblique distal pale marking in cell which broadly meets anterodistal wing margin; pale mark over base of wing extends only a third way to r–m crossvein and only slightly into proximal corner of anal cell; cell M2 with pale spot lying behind medial fork, one lying ahead of mediocubital fork, and two pale spots in distal portion, the second not meeting wing margin; cell M1 with two pale spots, the distal one not meeting wing margin; cell M4 with small round pale spot in mid-portion and a pale streak lying against proximal half of vein M3+4; anal cell with two small round pale spots in distal portion; vein M1 pale margined on distal portion. Macrotrichia moderately numerous, extending nearly to base of wing; radial cells with distinct lumens; CR 0,68. Halter infuscated.

Abdomen: Dark brown. Spermathecae (Plate 17d) two plus rudimentary third and sclerotized ring; oval with short slender necks; slightly unequal, measuring 0,051 by 0,038 mm and 0,048 by 0,035 mm.

Male.- - Similar to female, with usual sexual differences; antenna with long brown plume; last three segments with lengths in proportion of 85-80-100; sensory pattern 3, 10–12. Genitalia (Plate 17i): Ninth sternum without caudomedian excavation, ventral membrane not spiculate; ninth tergum moderately long and tapering, with long, slender, subparallel apicolateral processes. Basistyle moderately slender, with foot-shaped ventral root and slender dorsal root; dististyle moderately curved to bluntly pointed tip. Aedeagus

with trapezoidal basal arch, the basal arms moderately slender; distal process short with subparallel sides and two short distal points with semicircular concavity between on distal margin. Parameres (Plate 17h) each with dark basal knob; stem long and slender, slightly curved basally, straight in midportion, distally swollen and abruptly twisted to abruptly narrowed, tapering distal points bearing lateral fringing hairs.

Distribution.- - Brazil.

Types.- - Holotype, female, Belém, Pará, Brazil, August 1969, T.H.G. AITKEN, light trap in APEG Forest, terra firme, 32 m in tree canopy. Allotype, male, same data but February 1970. Paratypes, 5 females, same data, but dates May, July, August, November 1969, 1970.

Discussion.- - This species is named in honour of ALFRED RUSSELL WALLACE, explorer and geographer of the Darwinian era, who accompanied BATES on some of his journeys to the Amazon and also gave us a vivid narrative account of its geography and biota.

Culicoides wallacei is a member of the *discrepans* group and most similar in wing pattern to *dicrourus* WIRTH and BLANTON, which differs in its smaller size, more extensive pale wing markings with the U-shaped poststigmatic pale spot not partially subdivided, the antennal ratio 1,04, third palpal segment bearing a deep pit with smaller pore, male aedeagus with stouter basal arch and slender, forked tip, and the parameres shorter with distinct ventral lobe.

VII. Summary

The "maruins" of the genus *Culicoides* are important bloodsucking pests in the Amazon rain forests as elsewhere in the world. A key is given for the 60 Amazon species of which 15 are described as new: *albuquerquei, atripalpis, batesi, belemensis, carvalhoi, cylindricornis, fittkaui, freitasi, fusipalpis, goeldii, guamai, paramaruim, todatangae, vernoni,* and *wallacei.* Human biting records are presented for 18 species. Two large series of collections from light traps are compared: AITKEN took 44 species in the more fertile várzea region of the APEG Forest at Belém, while FITTKAU collected only 17 species in the nutrient poor headwater streams in Amazonas and Pará. A review is given of Amazon ecology, which may explain this faunal contrast.

VIII. Resumo

Os "maruins" do género *Culicoides* são importantes pragas sugadoras de sangue nas florestas pluviais da Amazônia, como em qualquer parte do mundo. É dada uma chave para as 60 espécies amazônicas das quais 15 são descritas como novas : *albuquerquei, atripalpis, batesi, belemensis, carvalhoi, cylindricornis, fittkaui, freitasi, fusipalpis, goeldii, guamai, paramaruim, todatangae, vernoni,* e *wallacei.* Para 18 espécies são apresentados recordes de picadas em pessoas. São comparadas duas grandes séries de coletas com armadhilas de luz: AITKEN recollien 44 espécies na região de várzea mais fertil, na floresta do APEG em Belém, enquanto FITTKAU coletou aponas 17 espécies nas correntes de cabeceiras pobres em nutrientes, no Amazonas e Pará. Faz-se uma revisão da ecologia da Amazônia que pode explicar êste contraste faunístico.

IX. References

BARBOSA, F.A.S. (1947): *Culicoides* (Diptera: Heleidae) da região neotropica.– Anais da Sociedade de Biologia de Pernambuco 7: 3–30, 9 pls.

BARRETTO, M.P. (1944): Sôbre o gênero *"Culicoides"* LATREILLE, 1809, com a descrição de três espêcies (Diptera, Ceratopogonidae).– Anais da Faculdade de Medicina da Universidade de São Paulo 20: 89–105, 4 pls.

BATES, H.W. (1863): The naturalist on the River Amazon. 2 vols. J. Murray, London.

BEQUAERT, J. (1926): Insects and man in tropical America.– Natural History 26: 133–146

BOUILLIENNE, R. (1930): Un voyage botanique dans le Bas-Amazone.– Archives de l'Instituté botanique de l'Universite de Liége 8: 1–185

BREELAND, S.G. (1960): Observations on the breeding habitats of some *Culicoides* and other Heleidae in the Panama Canal zone (Diptera).– Mosquito News 20:161–167

CABRERA, A. and J. YEPES (1940): Mamiferos Sud-Americanos. – Buenos Aires, Compania Argentina de Editores

CONDURÚ, J.M. (1968): The Guamá Ecological Research Area (APEG), IPEAN, Belém, Brazil.– Association for Tropical Biology Newsletter no. 10, pp. 10–12

COSTA LIMA, A. da (1937): Chave das espécies da *Culicoides* da região neotropica (Diptera: Ceratopogonidae).– Memorias do Instituto Oswaldo Cruz 32: 411–422

EGEER, W.A. and H.O. SCHWASSMANN (1964). Limnological studies in the Amazon estuary.– Verh. Internat. Verein. Limnol. 15: 1059–1066

EMSLEY, M.G. (1965): Speciation in *Heliconius* (Lep. Nymphalidae): morphology and geographic distribution.– Zoologica 50: 191–254

FITTKAU, E.J. (1963): *Manoa,* eine neue Gattung der Chironomidae (Diptera) aus Zentralamazonien.– Archiv für Hydrobiologie 59:373–390

FITTKAU, E.J. (1964): Remarks on limnology of central-Amazon rain-forest streams.– Verhandlungen der Internationalen Vereinigung für theoretische und angewandte Limnologie 15:1092–1096

FITTKAU, E.J. (1967): On the ecology of the Amazonian rain-forest streams.– in H. Lent (Ed.): Atas do simpósio sôbre a biota Amazônica. 3 (Limnologia): 97–108. Conselho de Pesquisas. Rio de Janeiro

FITTKAU, E.J. (1968): Eine neue Tanypodinae-Gattung, *Djalmabatista* (Chironomidae, Dipt.), aus dem brasilianischen Amazonasgebiet.– Amazoniana 1:327–349

FITTKAU, E.J. (1969): The Fauna of South America.– In Fittkau et al. (Eds.): Biogeography and Ecology in South America 2:624–658. W. Junk, The Hague.

FITTKAU, E.J. (1971a): Role of caimans in the nutrient regime of mouth-lakes of Amazon affluents (An hypothesis).– Biotropica 2:138–142

FITTKAU, E.J. (1972b): Distribution and ecology of Amazonian chironomids (Diptera).– Canadian Entomologist 103:407–413

FORATTINI, O.P. (1954): Nova espécie de *Culicoides* (Diptera, Ceratopogonidae) do estado de Goiaz, Brasil.– Folia Clin. et Biol. 21:315–320

FORATTINI, O.P. (1956): A new *Culicoides* from Panama.– Proceedings of the Entomological Society of Washington 58:35–36

FORATTINI, O.P. (1957): *Culicoides* da Região Neotropical (Dipters, Ceratopogonidae).– Arquivos da Faculdade de Higiene e Saúde Pública da Universidade São Paulo 11: 161–526

FORATTINI, O.P., E.X. RABELLO and D. PATTOLI (1958): *Culicoides* da Região Neotropical (Diptera, Ceratopogonidae). II Observações sôbre biologia em Condições naturais.– Arquivos da Faculdade de Higiene e Saúde Pública da Universidade de São Paulo 12: 1–52

FOX, I. (1946): A review of the species of biting midges or *Culicoides* from the Caribbean Region (Diptera, Ceratopogonidae).– Annals of the Entomological Society of America 39:248–258

FOX, I. (1952): Six new neotropical species of *Culicoides.*– Annals of the Entomological Society of America 45:364–368

FOX, I. and W.A. HOFFMAN (1944): New neotropical biting sandflies of the genus *Culicoides* (Diptera: Ceratopogonidae).– Puerto Rico Journal of Public Health and Tropical Medicine 20:108–111

GOELDI, E. (1905): Os Mosquitos no Pará.– Memorias do Museu Goeldi 4: 1–154, 21 pls.

HAFFER, J. (1969): Speciation in Amazonian forest Birds.– Science 165: 131–137

HOFFMAN, W.A. (1939): *Culicoides filariferus,* new species. Intermediate host of an unidentified filaria from southwestern Mexico.– Puerto Rico Journal of Public Health and Tropical Medicine 15: 172–174

LANE, J. (1945): Redescrição de Ceratopogonideos Neotropicos (Diptera: Ceratopogonidae).– Revista de Entomologia 16: 357–372

LEITÃO, C. de M. (1946): As zonas de fauna da América tropical.– Revista brasileira de geografia 8: 71–114

LUTZ, A. (1912): Contribuição para o estudo das "Ceratopogoninas" hematofagas encontradas no Brasil.– Memorias do Oswaldo Cruz 4: 1–32
LUTZ, A. (1913): Contribuição para o estudo das Ceratopogoninas hematofagas do Brasil (parte sistematica).– Memorias do Oswaldo Cruz 5: 45–73, 3 pls.
LUTZ, A. (1914): Contribuição para o connecimento das Ceratopogoninas do Brasil III. Aditamento terceiro e descrição de espécies que nao sugam sangue.– Memorias do Oswaldo Cruz 6: 81–99, 2 pls.
MACFIE, J.W.S. (1940): A report on a collection of Ceratopogonidae (Diptera) from British Guiana.– Entomologists Monthly Magazine 76: 25–32
MACFIE, J.W.S. (1948): Some species of *Culicoides* (Diptera, Ceratopogonidae) from the state of Chiapas, Mexico.– Annals of Tropical Medicine and Parasitology 42: 67–87
OLTMAN, R.E. (1967): Reconnaissance investigations of the discharge and water quantity of the Amazon.– In: H. Lent (Ed.), Atas do simpósio sôbre a biota Amazônica. 3 (Limnologia): 163–185. Conselho de Pesquisas, Rio de Janeiro
ORTIZ, I. (1950a): Estudios en *Culicoides*. II. Diptera, Ceratopogonidae. *Culicoides lanei* n. sp. de Panama.– Revista de Sanidad y Asistencia Social 15: 431–433
ORTIZ, I. (1950b): Estudios en *Culicoides*. IV. Revision de las especies americanas del sub-genero *Hoffmania* FOX 1948, con la descripcion de dos nuevas especies.– Revista de Sanidad y Asistencia Social 15: 437–460
ORTIZ, I. (1950c): Informes sôbre una nueva especie y lista de los machos cuyas genitalias son conocidas.– Revista de Sanidad y Asistencia Social 15: 461–465
ORTIZ, I. (1951a): Estudios en *Culicoides* (Diptera, Ceratopogonidae). 9. Sôbre los caracteres diferenciales entre *Culicoides paraensis* (GOELDI, 1905), *C. stellifer* (COQUILLETT, 1901), y *C. lanei* (ORTIZ,1950). Descripción de cuatro nuevas espécies con la redescripción de algunas otras poco conocidas.– Revista de Sanidad y Asistencia Social 16: 573–591
ORTIZ, I. (1951b): Estudios en *Culicoides* (Diptera, Ceratopogonidae). VI. *Culicoides bricenoi* n. sp.– Boletin de Laboratorio de la Clinica "Luis Razetti" 16: 442–448
ORTIZ, I. (1952): Nota sôbre la presencia de "*Culicoides eublepharus*" MACFIE, 1948 (Diptera, Ceratopogonidae) en Venezuela. Descripción de la armadura genital del macho.– Acta Cientifica Venezolana 3: 129
ORTIZ, I. (1953): Nuevo contribución al conocimiento de los caracteres morfológicos externos de las hembras Americanas del genero *Culicoides* Ltr. (Diptera, Ceratopogonidae) con una espermateca.– Revista de Sanidad y Asistencia Social 18: 797–806
ORTIZ, I. (1954): Sôbre dos nuevos dipteros hematofagos del genero *Culicoides* (Nematocera, Ceratopogonidae).– Archivos Venezolana de Patología tropical y Parasitologiá Médica 2: 221–226
ORTIZ, I. (1956): Sôbre un pequeno diptero de la region del Auyantepuy.– Boletin Venezolano de Laboratorio Clinico 1: 93–96
ORTIZ, I. (1958): Sôbre *Johannseniella fluviatilis* LUTZ, 1914, y *Culicoides pachymerus* LUTZ, 1914 (Diptera: Ceratopogonidae).– Boletin Venezolana de Laboratorio Clinico 3: 37–43
ORTIZ, A. and L.A. LEON (1955): Los *Culicoides* (Diptera: Ceratopogonidae) de la República del Ecuador.– Boletin de Informaciones Científicas Nacionales No. 67, pp. 564–590
ORTIZ, I. and M. MIRSA (1951): Estudios en *Culicoides* (Diptera, Ceratopogonidae). Descripción de dos nuevas espécies: *Culicoides avilaensis* y *C. discrepans*, y del macho de *C. leopoldoi* ORTIZ, 1951. Redescripción de *C. limai* BARRETTO, 1944, *C. baueri* HOFFMAN, 1925, *C. lichyi* FLOCH and ABONNENC, 1949 y *C. pusillus* LUTZ, 1913.– Revista de Sanidad y Asistencia Social 16: 593–605
ORTIZ, I. and M. MIRSA (1952): Sôbre las espécies Americanas del género "*Culicoides*" Latr. (Diptera, "Ceratopogonidae") con una espermateca.– Acta Cientifica Venezolana 3: 125–128
RICHARDS, P.W. (1952): The tropical rain forest. University Press, Cambridge. 450 pp.
SIOLI, H. (1956): Über Natur und Mensch im brasilianischen Amazonasgebiet.– Erdkunde 10: 89–109
SIOLI, H. (1964): General features of the limnology of Amazonia.– Verhandlungen der Internationalen Vereinigung für theoretische und angewandte Limnologie 15: 1053–1058
SIOLI, H. (1967): Studies in Amazonian waters.– In: H. Lent (Ed.), Atas do simpósio sôbre a biota Amazônica. 3 (Limnologia): 9–50. Conselho de Pesquisas, Rio de Janeiro
SIOLI, H. (1968): Zur Ökologie des Amazonas-Gebietes.– In: Fittkau et al. (Eds.), Biogeography and Ecology in South America 1: 137–170. W. Junk, The Hague

SIOLI, H. and H. KLINGE (1961): Über Gewässer und Böden des brasilianischen Amazonasgebietes.– Die Erde, Berlin 92: 205–219
ULE, E. (1908): Die Pflanzenformationen des Amazonas-Gebietes.– Englers Botanische Jahrbücher 40: 114–172, 398–443
WALLACE, A.R. (1853): A narrative of travels on the Amazon and Rio Negro.– Reeve and Co., London. 542 pp.
WARMKE, H.E. (1952): Studies on natural pollination of *Hevea brasiliensis* in Brazil.– Science 116: 474–475
WILLIAMS, R.W. (1964): Observations on habitats of *Culicoides* larvae in Trinidad, W.I. (Diptera: Ceratopogonidae).– Annals of the Entomological Society of America 57: 462–466
WIRTH, W.W. and F.S. BLANTON (1953): Studies in Panama *Culicoides* (Diptera: Heleidae). I. Description of six new species.– Journal of the Washington Academy of Science 43: 69–77
WIRTH, W.W. and F.S. BLANTON (1955): Studies in Panama *Culicoides* (Diptera, Heleidae). IV. Description of three new species.– Bulletin of the Brooklyn Entomological Society 50: 100–106
WIRTH, W.W. and F.S. BLANTON (1956a): Studies in Panama *Culicoides* VIII. The Neotropical species of the *guttatus* group of the subgenus *Hoffmania* (Diptera, Heleidae).– Proceedings of the Entomological Society of Washington 58: 305–326
WIRTH, W.W. and F.S. BLANTON (1956b): Studies in Panama *Culicoides* (Diptera, Heleidae) IX. Two new species related to *leoni* BARBOSA and *reevesi* WIRTH.– Bulletin of the Brooklyn Entomological Society 51: 45–52
WIRTH, W.W. and F.S. BLANTON (1956c): Redescriptions of four species of Neotropical *Culicoides* of the *debilipalpis* (Diptera, Heleidae).– Journal of the Washington Academy of Science 46: 186–190
WIRTH, W.W. and F.S. BLANTON (1959): Biting midges of the genus *Culicoides* from Panama (Diptera: Heleidae).– Proceedings of the United States National Museum 109: 237–482
WIRTH, W.W. and F.S. BLANTON (1968a): A revision of the Neotropical biting midges of the *hylas* group of *Culicoides* (Diptera, Ceratopogonidae).– The Florida Entomologist 51: 201–215
WIRTH, W.W. and F.S. BLANTON (1968b): A new *Culicoides* species from Guyana (Diptera: Ceratopogonidae).– The Florida Entomologist 51: 251–252
WIRTH, W.W. and F.S. BLANTON (1971): New Neotropical sandflies of the *Culicoides debilipalpis* group (Diptera: Ceratopogonidae).– Proceedings of the Entomological Society of Washington 73: 34–43

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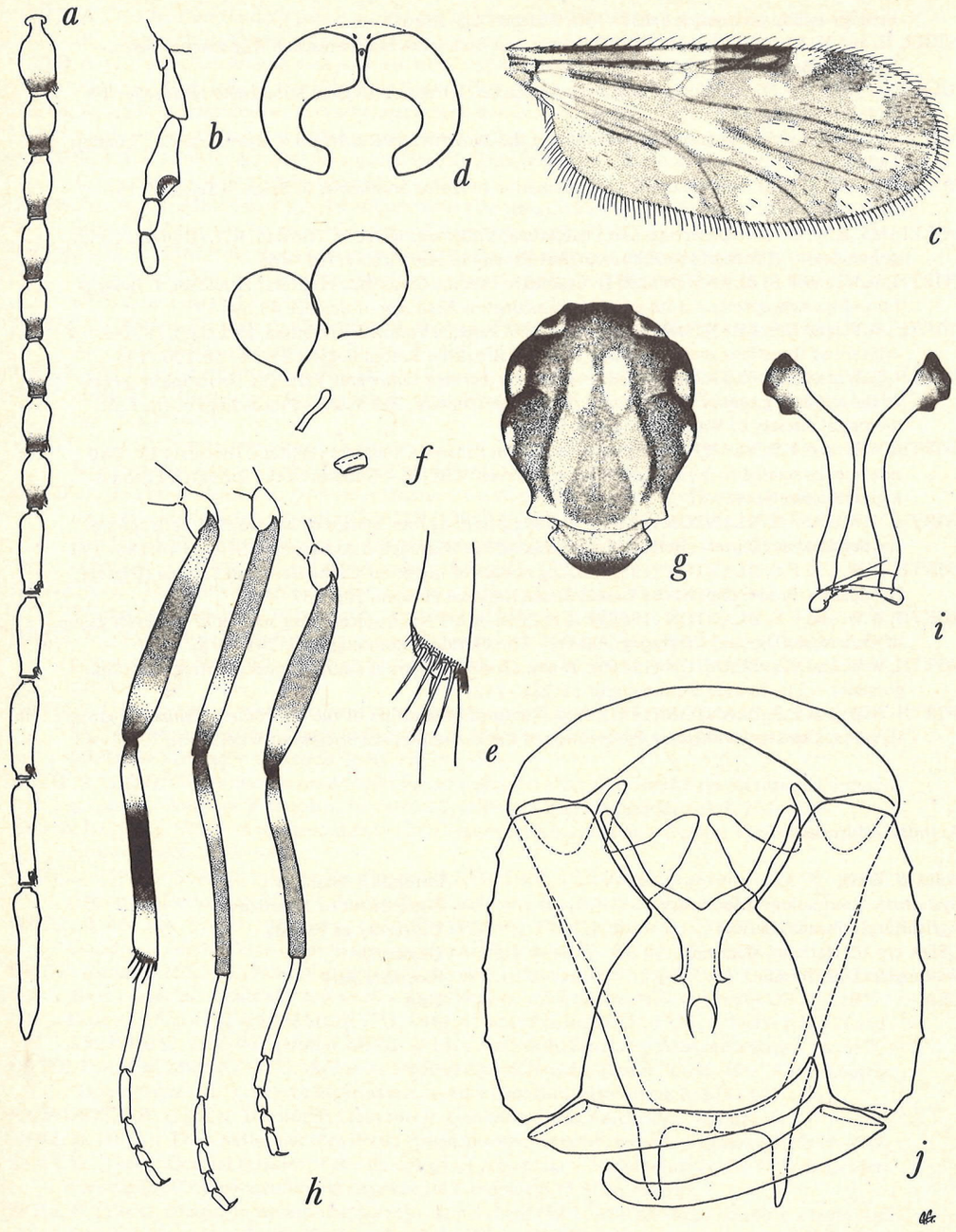

Plate 1. *Culicoides albuquerquei*: a, female antenna; b, female palpus; c, female wing; d, female eye separation; e, tibial comb; f, spermathecae; g, thoracic pattern; h, legs; i, male parameres; j, male genitalia, parameres removed.

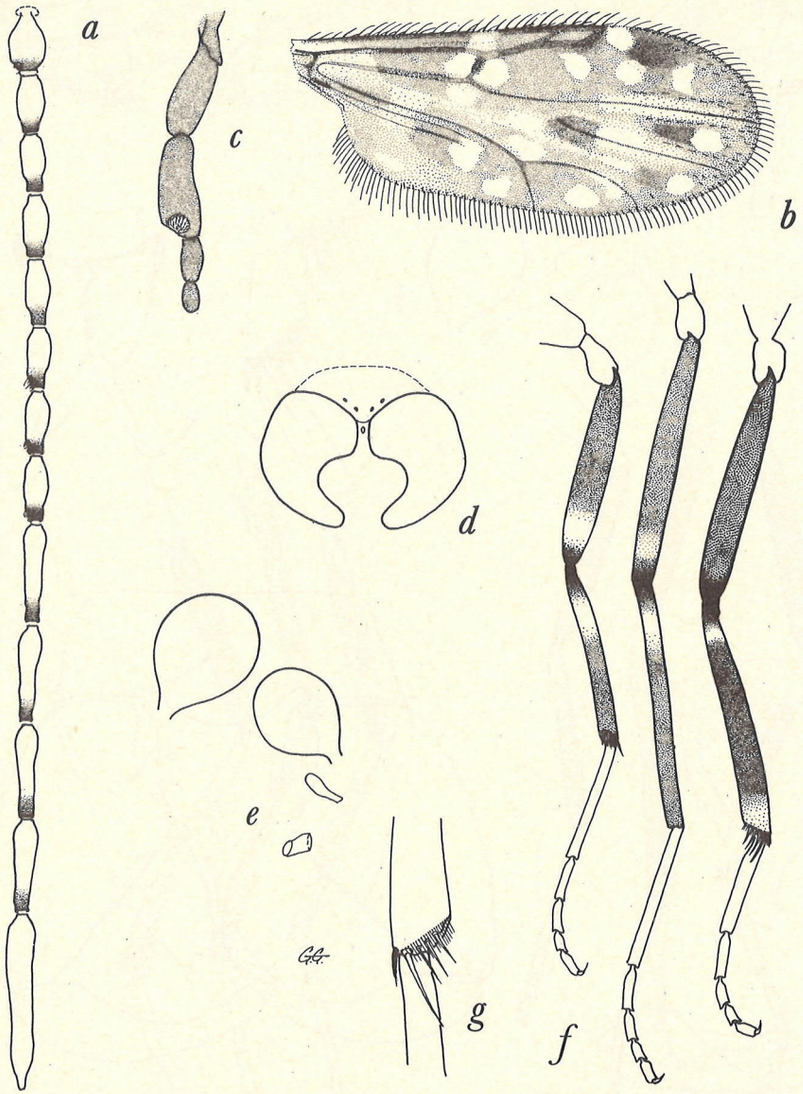

Plate 2. *Culicoides atripalpis*, female: a, antenna; b, wing; c, palpus; d, eye separation; e, spermathecae; f, legs; g, tibial comb.

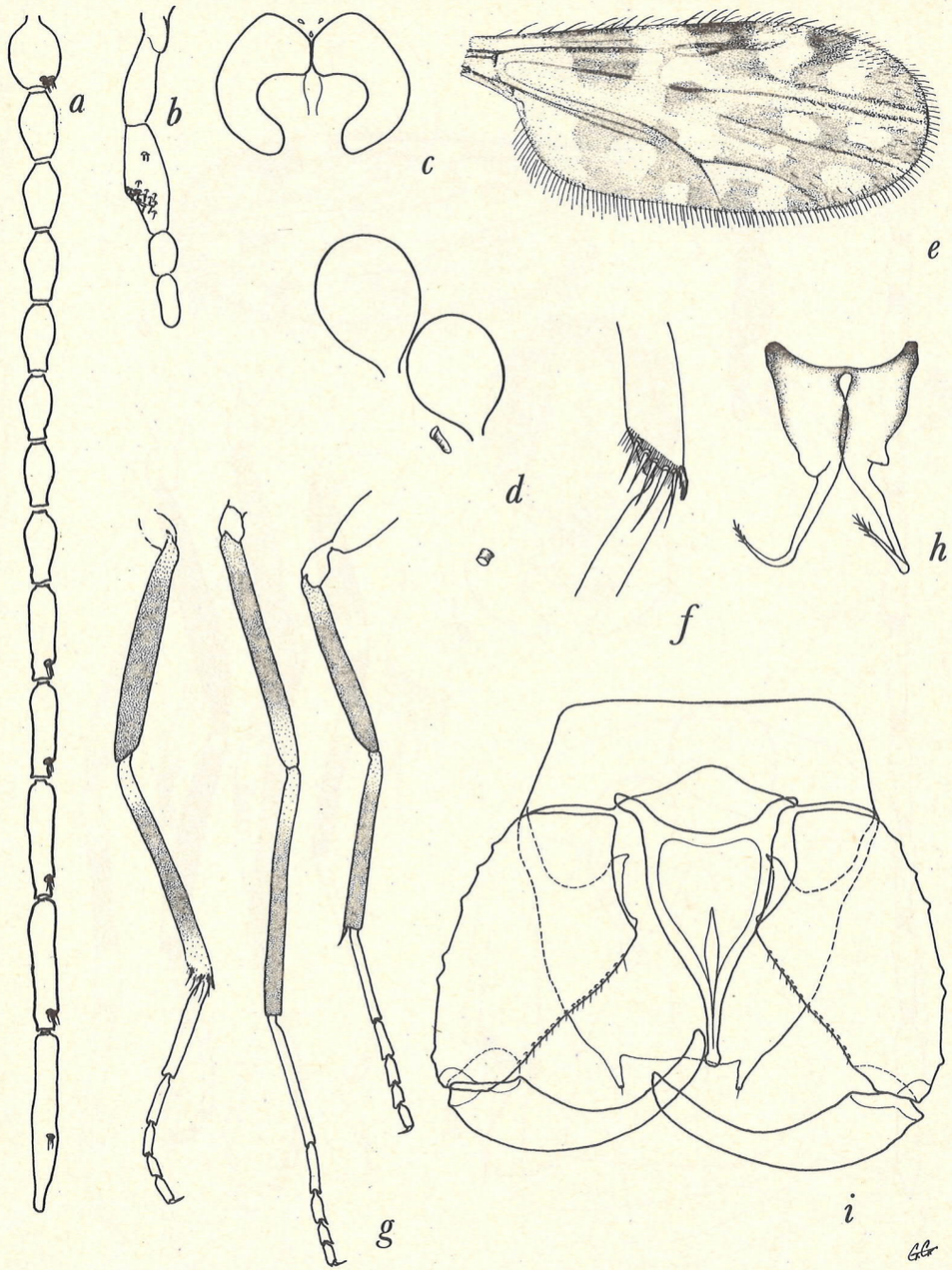

Plate 3. *Culicoides batesi*: a, female antenna; b, female palpus; c, female eye separation; d, spermathecae; e, female wing; f, tibial comb; g, legs; h, male parameres; i, male genitalia, parameres removed.

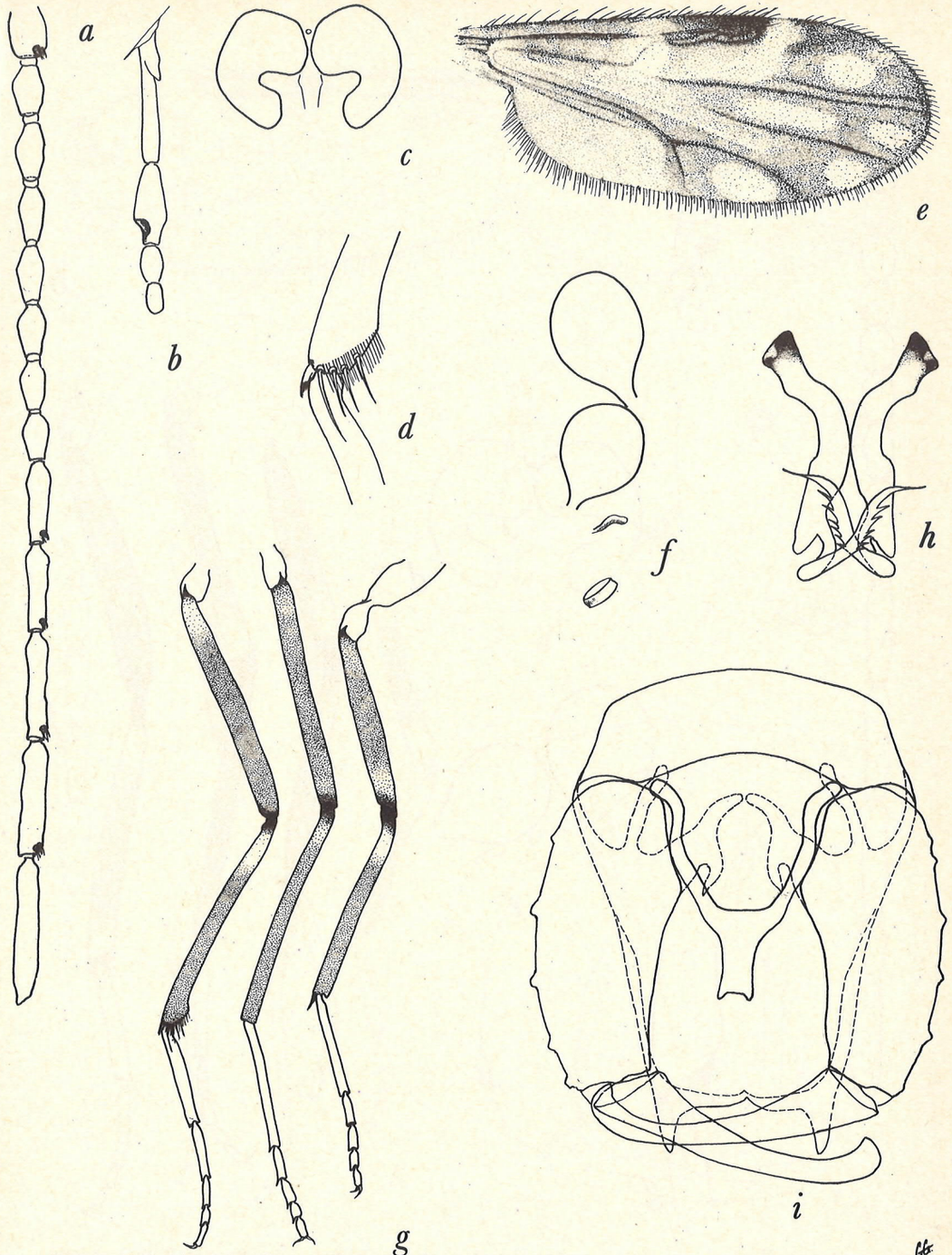

Plate 4. *Culicoides belemensis*: a, female antenna; b, female palpus; c, female eye separation; d, tibial comb; e, female wing; f, spermathecae; g, legs; h, male parameres; i, male genitalia, parameres removed.

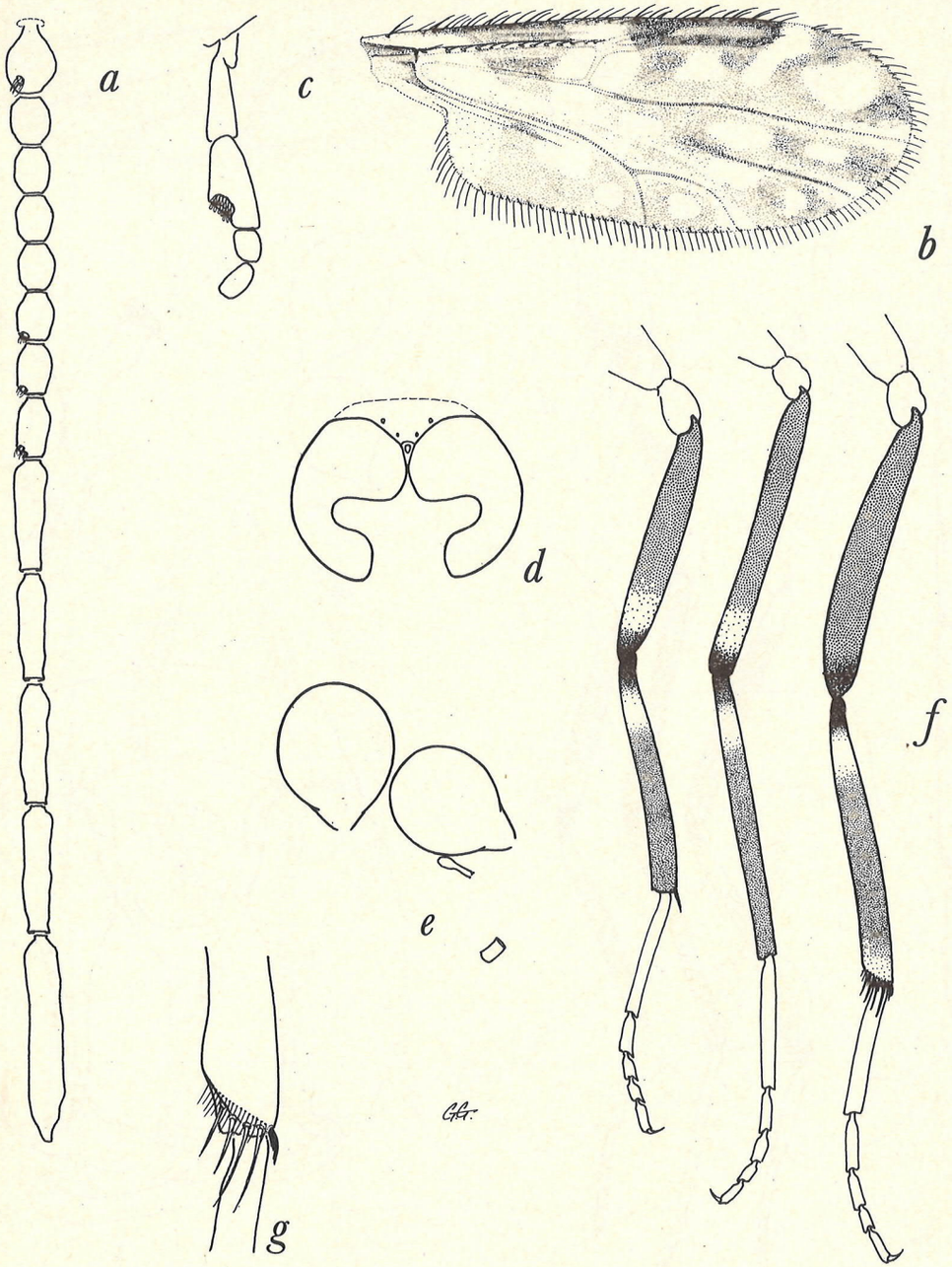

Plate 5. *Culicoides bricenoi*, female: a, antenna; b, wing; c, palpus; d, eye separation; e, spermathecae; f, legs; g, tibial comb.

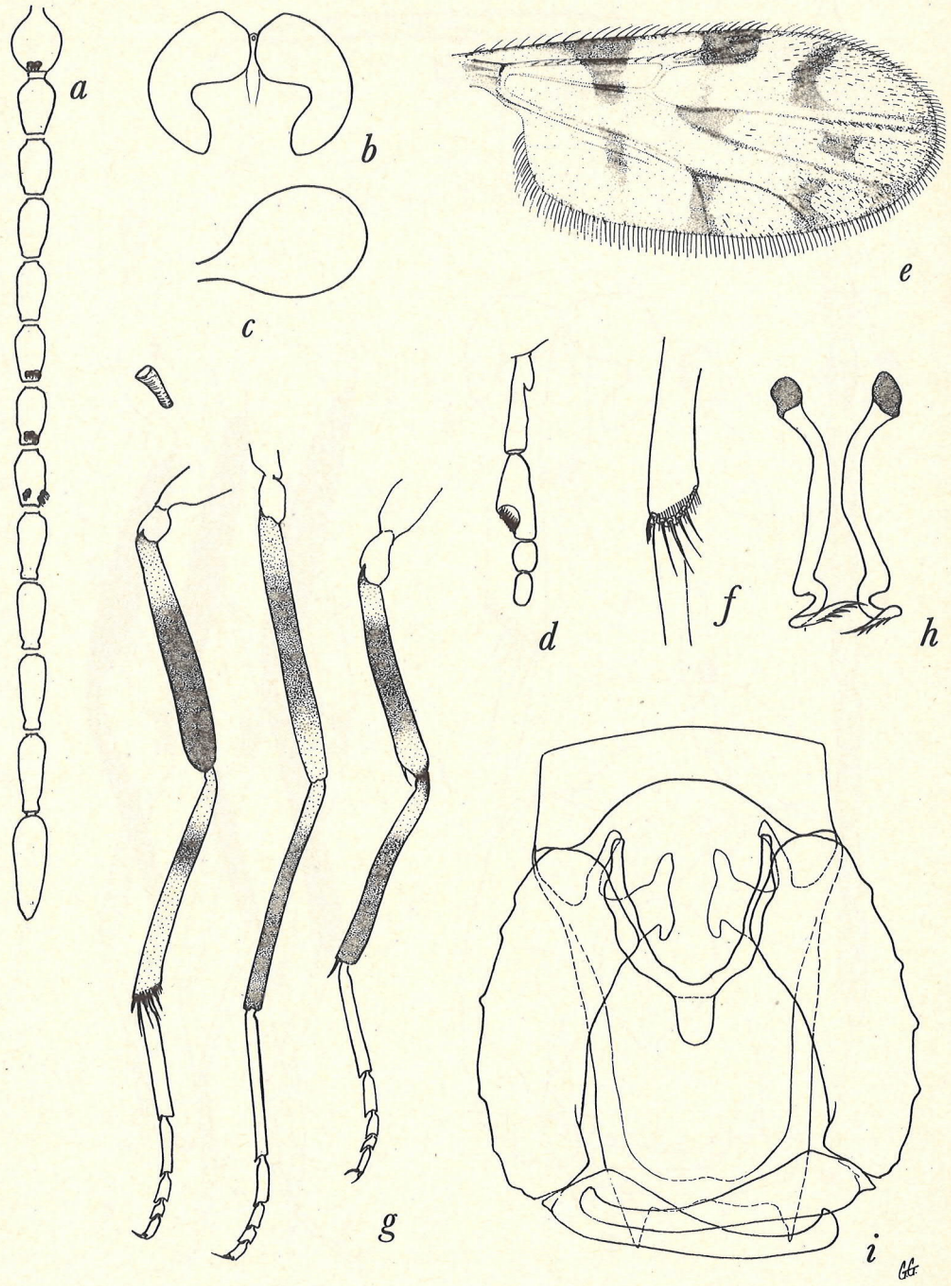

Plate 6. *Culicoides carvalhoi*: a, female antenna; b, female eye separation; c, spermathecae; d, female palpus; e, female wing; f, tibial comb; g, legs; h, male parameres; i, male genitalia, parameres removed.

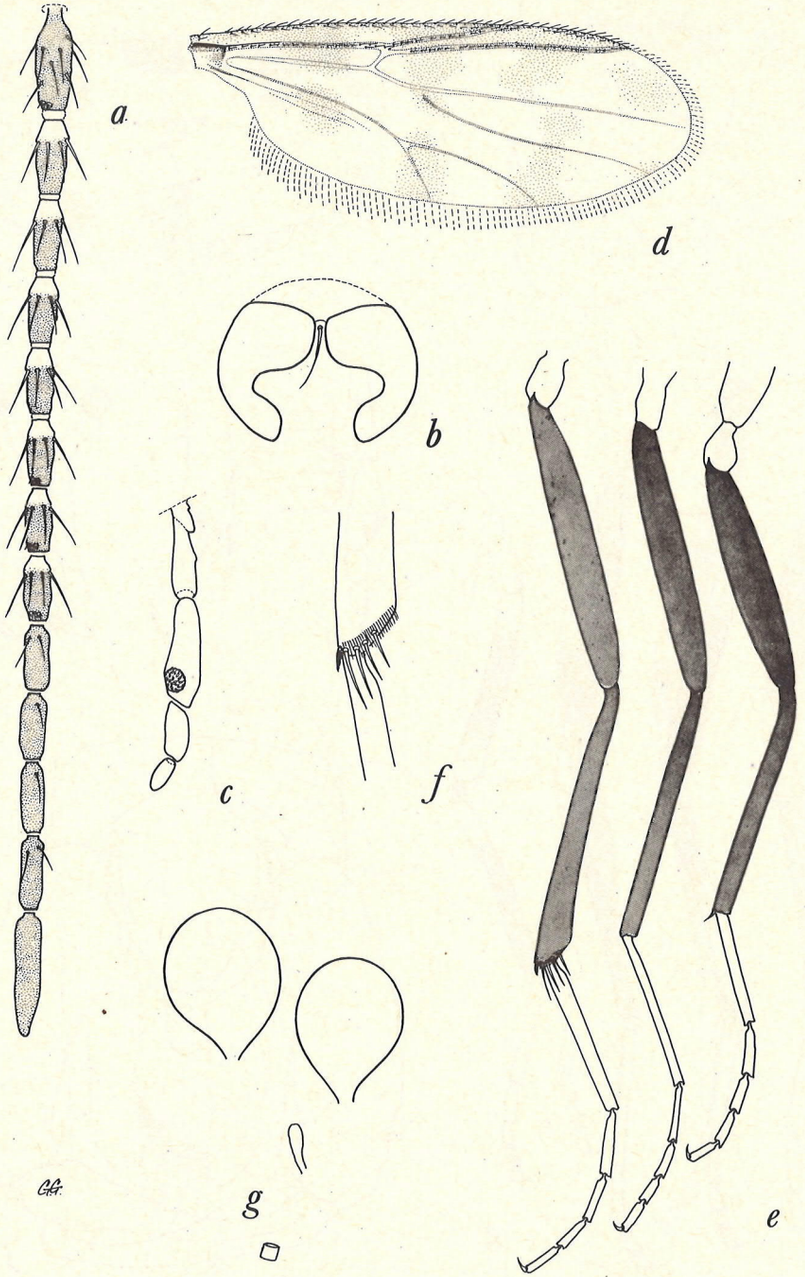

Plate 7. *Culicoides cylindricornis*, female: a, antenna; b, eye separation; c, palpus; d, wing; e, legs; f, tibial comb; g, spermathecae.

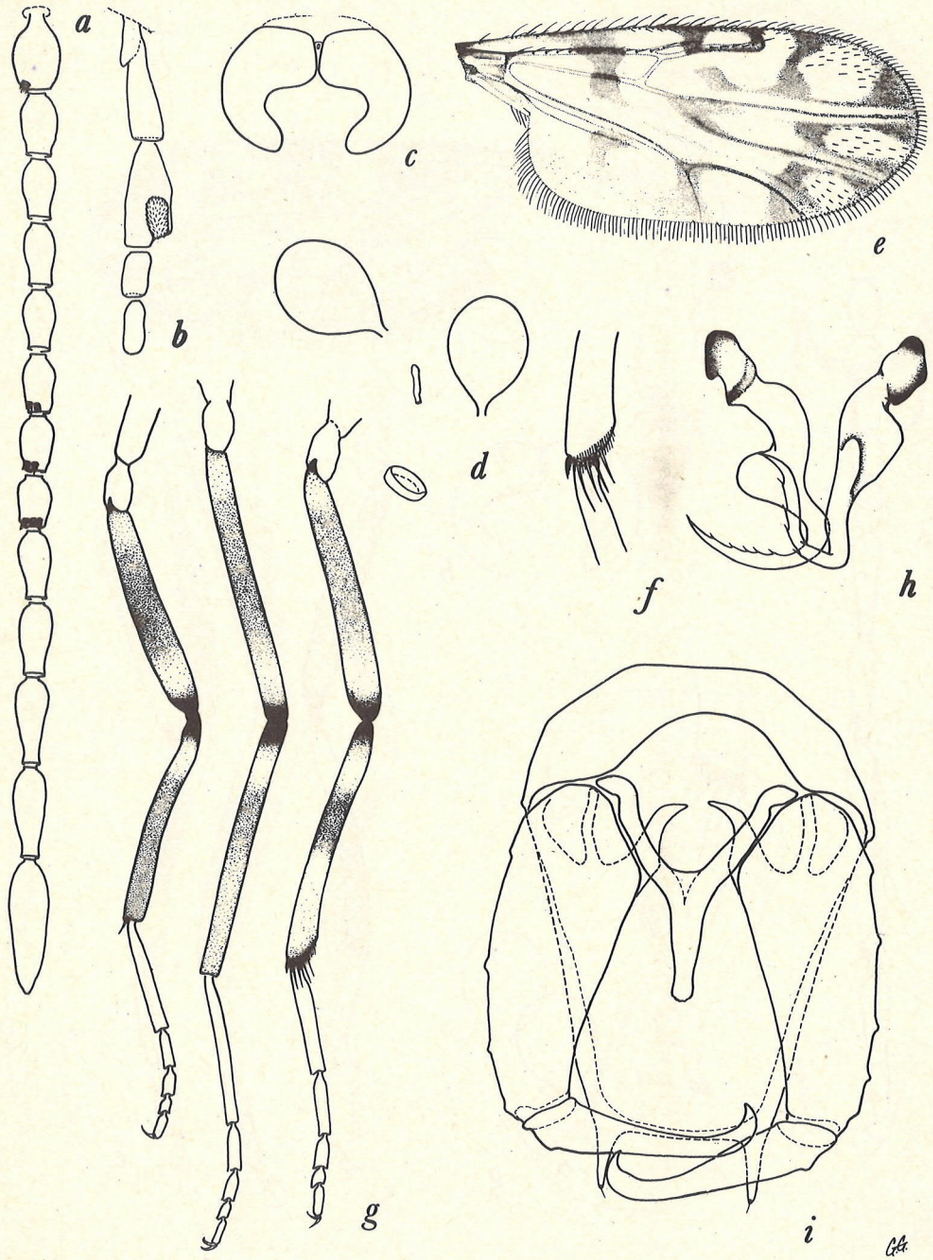

Plate 8. *Culicoides fittkaui*: a, female antenna; b, female palpus; c, female eye separation; d, spermathecae; e, female wing; f, tibial comb; g, legs; h, male parameres; i, male genitalia, parameres removed.

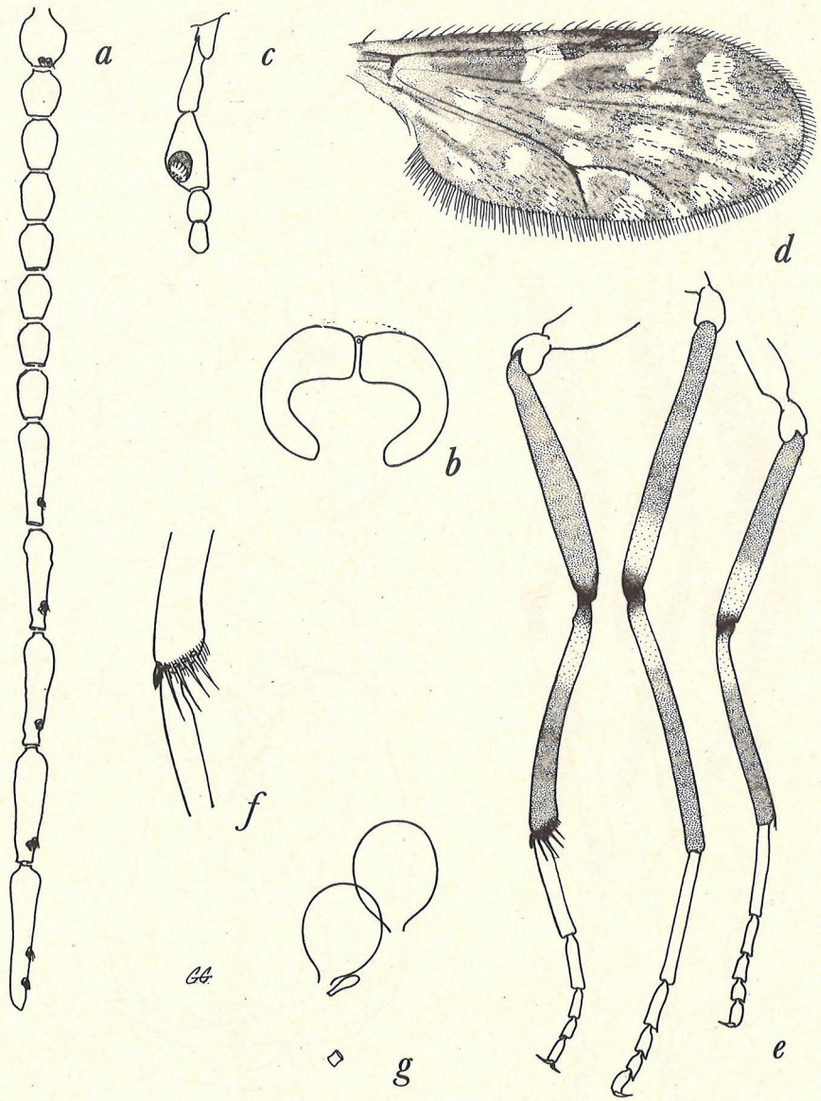

Plate 9. *Culicoides freitasi*, female: a, antenna; b, eye separation; c, palpus; d, wing; e, legs; f, tibial comb; g, spermathecae.

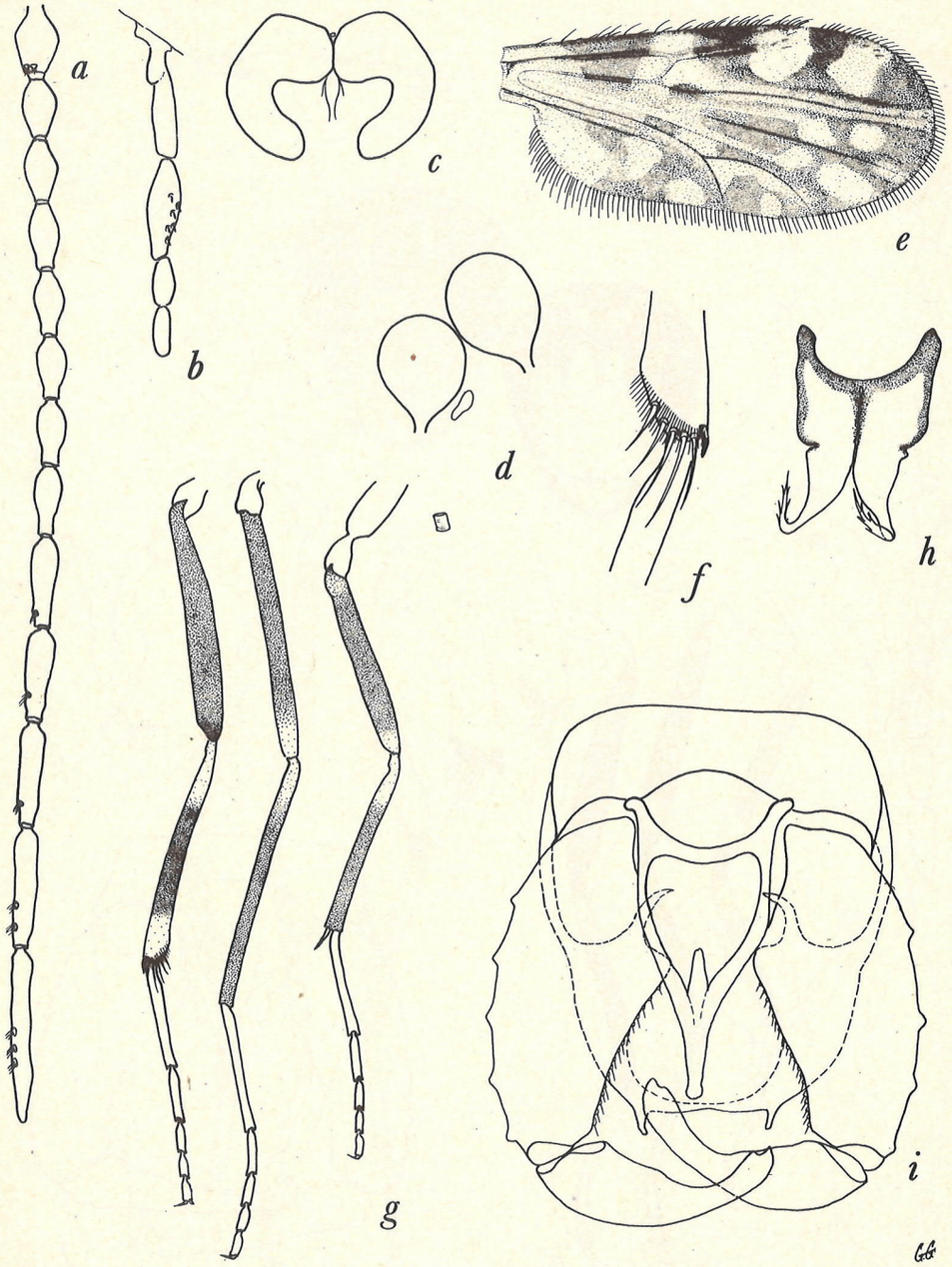

Plate 10. *Culicoides fusipalpis*: a, female antenna; b, female palpus; c, female eye separation; d, spermathecae; e, female wing; f, tibial comb; g, legs; h, male parameres; i, male genitalia, parameres removed.

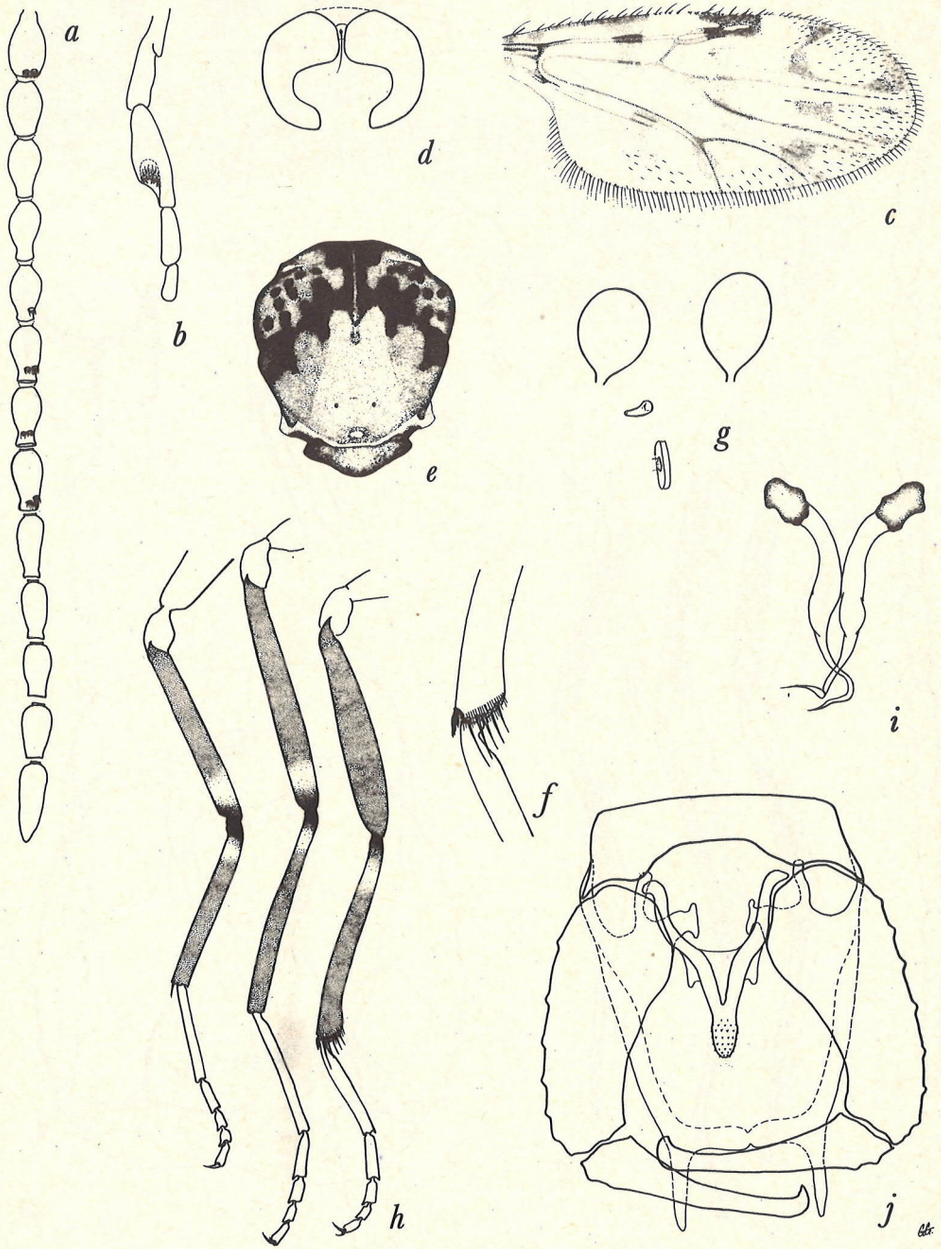

Plate 11. *Culicoides goeldii*: a, female antenna; b, female palpus; c, female wing; d, female eye separation; e, thoracic pattern; f, tibial comb; g, spermathecae; h, legs; i, male parameres; j, male genitalia, parameres removed.

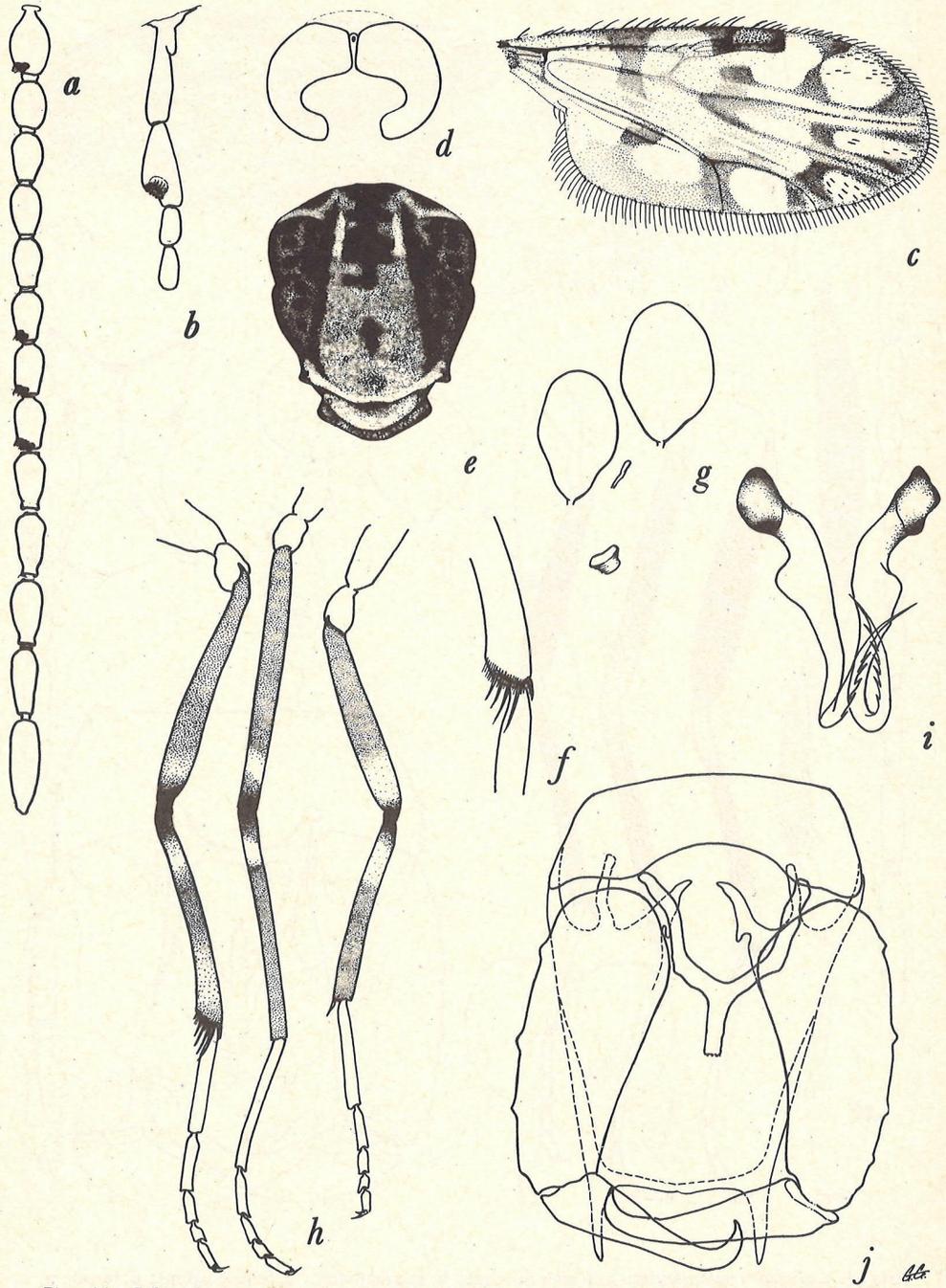

Plate 12. *Culicoides guamai*: a, female antenna; b, female palpus; c, female wing; d, female eye separation; e, thoracic pattern; f, tibial comb; g, spermathecae; h, legs; i, male parameres; j, male genitalia, parameres removed.

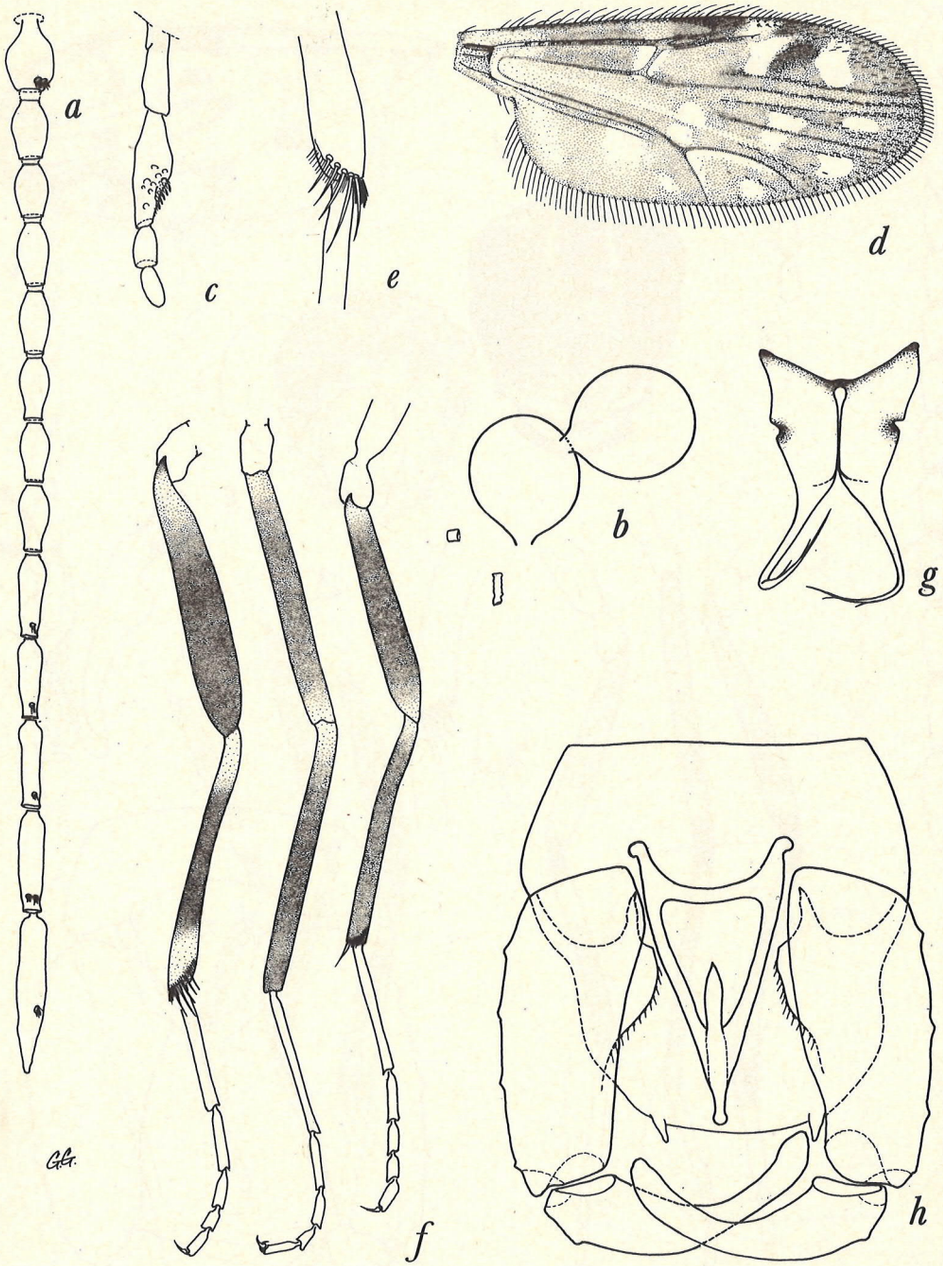

Plate 13. *Culicoides paramaruim*: a, female antenna; b, spermathecae; c, female palpus; d, female w e, tibial comb; f, legs; g, male parameres; h, male genitalia, parameres removed.

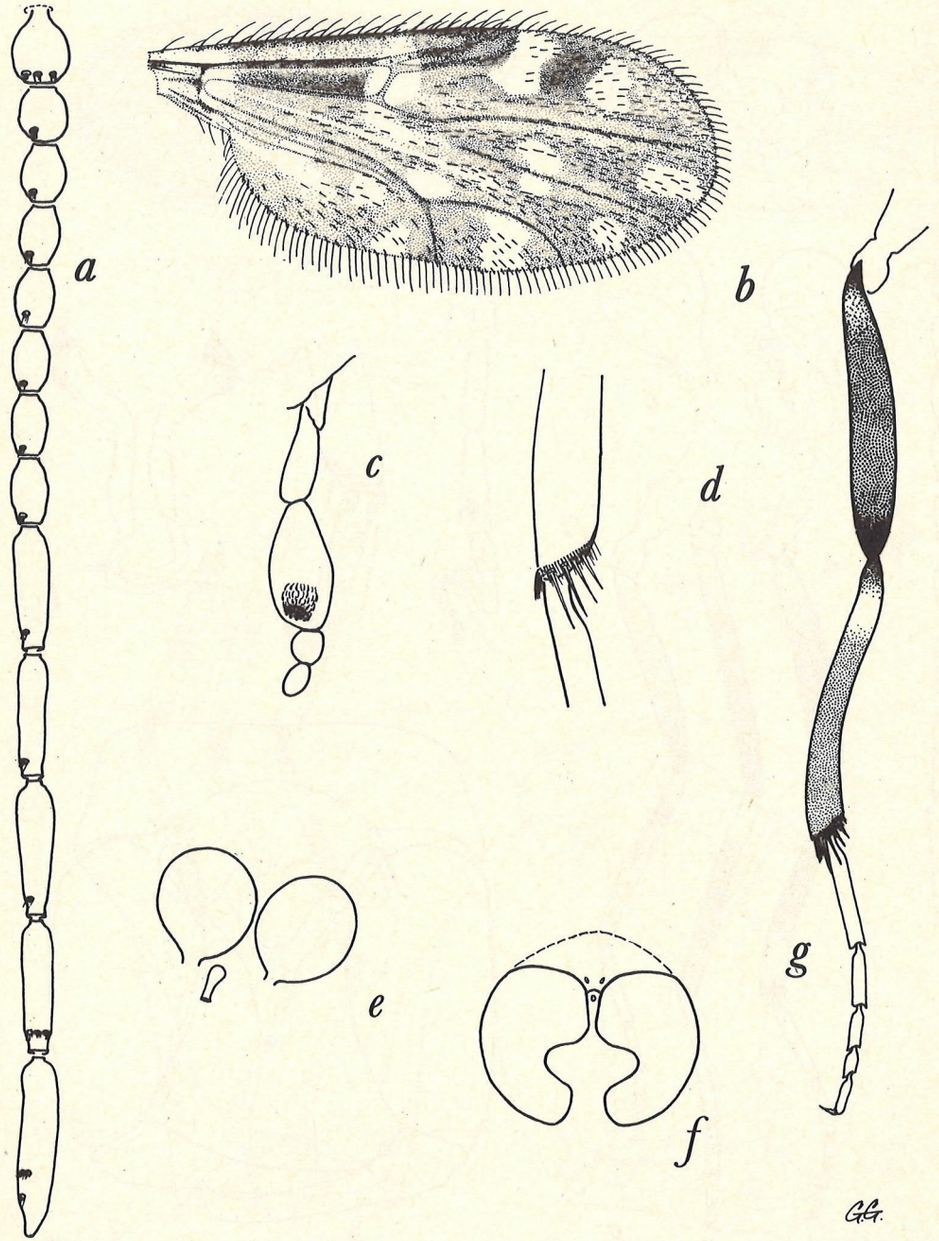

Plate 14. *Culicoides pilosus*, female: a, antenna; b, wing; c, palpus; d, tibial comb; e, spermathecae; f, eye separation; g, hind leg.

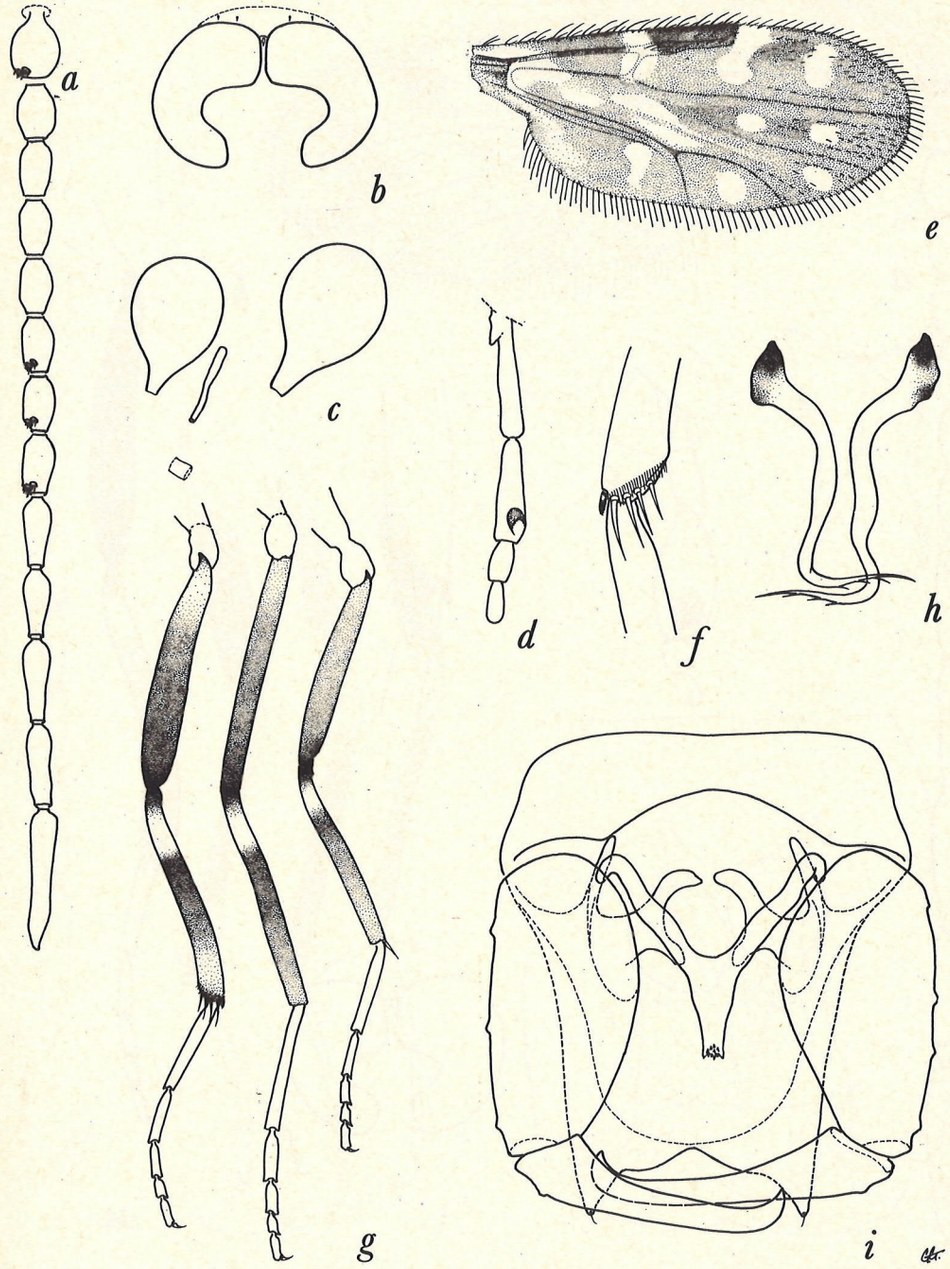

Plate 15. *Culicoides todatangae*: a, female antenna; b, female eye separation; c, spermathecae; d, female palpus; e, female wing; f, tibial comb; g, legs; h, male parameres; i, male genitalia, parameres removed.

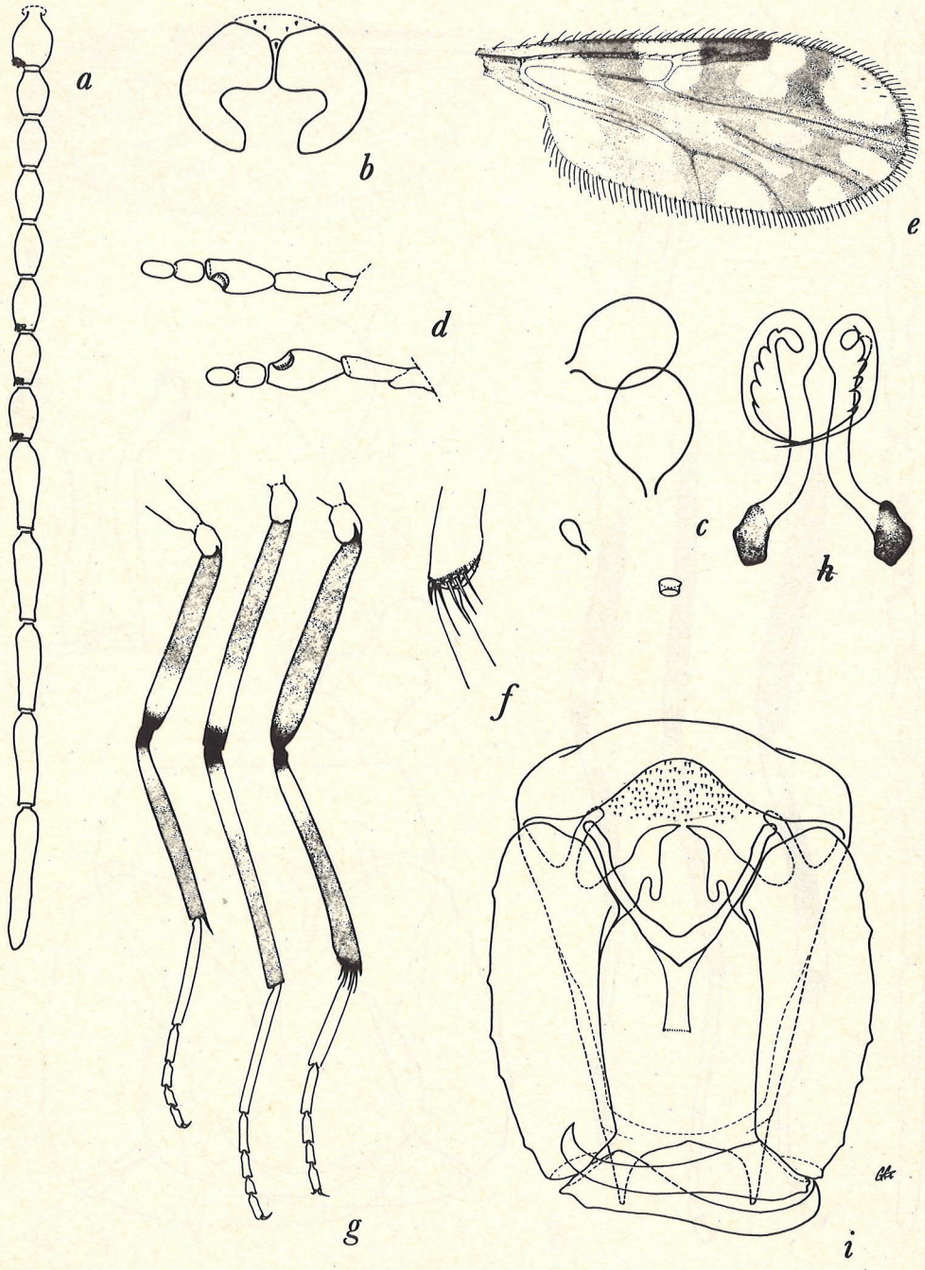

Plate 16. *Culicoides vernoni*: a, female antenna; b, female eye separation; c, spermathecae; d, female palpus, two examples; e. female wing; f, tibial comb; g, legs; h, male parameres; i, male genitalia, parameres removed.

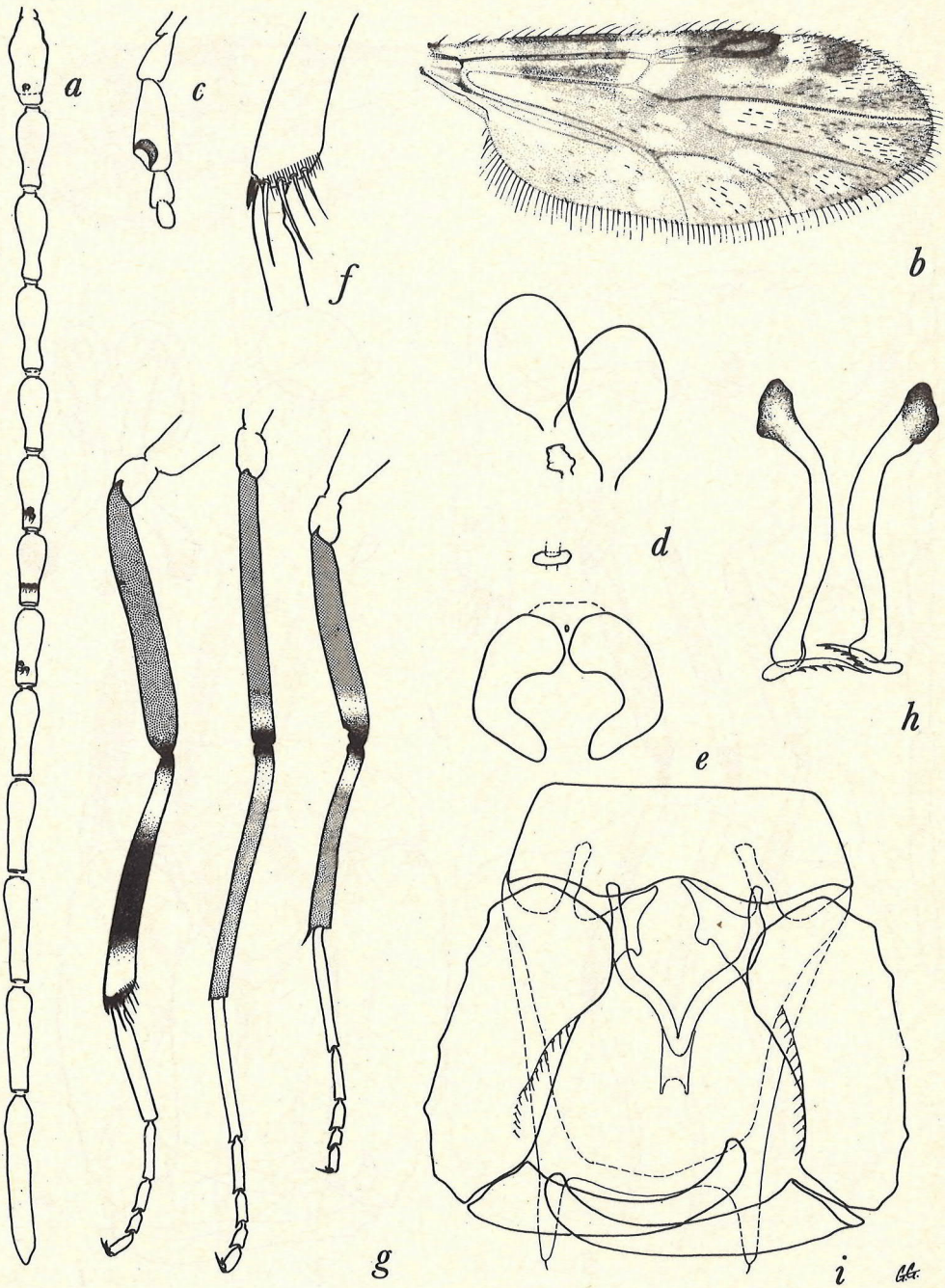

Plate 17. *Culicoides wallacei*: a, female antenna; b, female wing; c, female palpus; d, spermathecae; e, female eye separation; f, tibial comb; g, legs; h, male parameres; i, male genitalia, parameres removed.